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GENETICAL RESEARCH AS APPLIED TO PLANT BREEDING IN POST-WAR INDIA

IN any scheme of organisation of scientific research in India for national development, the study of Genetics should receive its proper attention. It is a young and rapidly growing science basic to modern plant breeding which is practised in all civilised countries for increased production of farm, forest and fruit crops. It is true that for thousands of years before the discovery of genetical methods for breeding, superior varieties of crops were produced; but these were mainly due to the efforts of individual, intuitive, clever men who applied a sort of conscious selection to the large number of variants occurring spontaneously or induced by random racial crossing. With the development of genetical knowledge during the present century, however, breeding practice was rationalised and many wrong corners and pitfalls which beset early breeders were removed. The concept of the *gene* as the unit of inheritance and the identification of the chromosomes as a string of genes controlling development, variation and evolution in living organisms have put new tools in the hands of the breeder. Recent knowledge regarding induction and utilisation of polyploids, wide crosses, mutants and hybrid vigour, arising from genetical researches, has opened up new possibilities for increased production. In fact, the new knowledge that has accumulated from researches on chromosomes—the bearers of hereditary characters—has made it possible to make new plants to order. The advice of one of the greatest authorities in genetics to breeders who desire to be most practical—"Know your chromosomes"—indicates the importance of the study of Genetics.

It may not be out of place here to briefly mention how genetic research is being applied to secure increased production in some of the more progressive countries.

GENETIC RESEARCH ABROAD

Taking the case of Sweden, since the last War (1914-18) she has made tremendous progress in the matter of production of food and other crops as a result of the application of genetic research to plant-breeding. The annual yields of wheat and sugar-beet have been raised to a level at which the country is self-sufficient. This has been done by the application of new techniques such as by the use of twin seedlings, heat, colchicine, etc., for producing tetraploids and other suitable synthetic types. Tetraploid forms of clover, lucerne, herbage grasses, barley, rye, potatoes, flax and other crops have also been produced and some of them have already been found to be of practical use. Amphidiploid wheat-rye hybrids, first raised in the U.S.S.R., are now regularly produced by doubling of chromosomes in crosses between suitable parents for different conditions and purposes. A new grain crop, *viz.*, *Triticale*, of special value for Sweden and other countries has been synthesised—"the first such invention for the last three thousand years". Higher yielding barley strains have also been obtained from X-rayed progenies, thus dispelling the misgivings of geneticists

regarding the value of X-ray mutants for breeding purposes.

The nutritional aspect in breeding was not lost sight of. Triploid apples with richer vitamin and better keeping quality have been obtained and potato varieties with higher ascorbic acid content are being bred.

Realizing the importance of breeding to forest trees, researches were initiated and within a short period significant results have been obtained. A survey of the forest resources in the country was made and triploid aspens and other trees with twice the growth-rates of the neighbouring diploid trees have been obtained. Polyploidy is being induced artificially in other trees for production of superior forms. Newer methods of propagation and grafting are also under investigation. Fundamental researches in genetics and cytology carried out at the cytogenetic laboratory in Svalöf are discovering new principles and techniques of paramount importance to breeding.

In the U.S.S.R. new and peculiar problems of production are being solved by the application of genetic research. Heavy frost and drought are constant enemies to successful crop production in that country. New synthetic crops are being produced from wide crosses which heretofore were considered useless because of the sterility involved in them, to suit different conditions and purposes. The amphidiploid hybrids of wheat with rye, *Agropyron* and *Ægilops* are a few instances in point. Extensive interspecific and intergeneric hybridisations have been undertaken in that country for the production of desirable types in rye, potato and other crops. This has been made possible by the wonderful wealth of wild genes the Russian geneticists have built up in their living collections of less well-known economic plants by surveying their own country and by sending out expeditions to other countries of origin of cultivated plants. A remarkable instance of this type of work concerns the potato. The potato introduced into Europe three and a half centuries ago set seed readily and gave rise to a number of varieties by segregation in the course of a number of years. The genes present in these varieties were utilized and all the desirable combinations of them were obtained and ultimately a position of stalemate was reached when no further improvement appeared possible although several problems such as those of Late Blight and virus diseases were unsolved. The necessity for importing fresh genes for disease-resistance was felt and a search for these genes in the original home of the potato was undertaken. Expeditions were sent to Central America and Mexico between the years 1926 and 1932 by the Russian geneticists and a large number of hitherto unknown tuber-bearing *Solanums* was discovered. As a result of this, a revolution in our ideas as to the origin and botanic status of the potato has occurred and possibilities of breeding potato to all the desired requirements of industrialised man are in sight. Another very important discovery of a Russian geneticist concerning the chimeral nature of many of our domestic potatoes has proved to be of great significance to breeding.

The extensive collection of living plants has also helped in bringing into cultivation new and substitute crops whenever found necessary. The new investigations of the Russian geneticists on the breeding of rubber plants from *Taraxacum koksaghyz* and other *Compositæ* are examples.

In America, the conquest of stem rust and other diseases of wheat and the production of hybrid corn, which has literally revolutionised corn production in that country, are eloquent testimonies to the successful application of genetic principles to increased crop production.

In England, continued cytogenetic researches on fruit trees, particularly those belonging to the genera *Fragaria*, *Rubus* and *Prunus*, have thrown light on the origin of many of these cultivated fruits and the mechanism of reproduction in them and has helped in the evolution of new and superior varieties.

With this background of research activities abroad it may be worthwhile to examine the status of genetic research in India and the possibilities of its extension in the future for national development.

Present Position of Genetic Research in India

The application of genetic research to increased crop production may be said to have started in India with the opening of the Imperial Agricultural Research Institute and the Provincial Departments of Agriculture about the year 1905. The establishment of the Indian Central Cotton Committee and the Imperial Council of Agricultural Research later on, also supplemented activities in this direction. So far, the plant breeders and geneticists have produced many superior yielding crop varieties, mainly by the application of the time-honoured method of selection to naturally varying populations or to the segregates of inter-racial hybrids. Considerable success has been obtained with self-fertilized crops like the cereals and with the vegetatively propagated sugarcane. Breeding for special attributes such as disease- and pest-resistance, better quality and adaptability to regions of drought and frost have not made much progress. Suitable techniques for breeding cross-fertilized crops like mustards and maize have not been thoroughly worked out. Fundamental genetic research such as would lead to the discovery of new principles and techniques has not been taken up on a large scale. No doubt the inheritance of several morphological characters in a number of crop plants has been studied but these characters are of very limited application to breeding compared to the more complicated physiological characters which control yield and quality and which have received very little attention in India. The extensive use of the new weapons of genetic research such as polyploidy, hybrid vigour, mutations, chimeras, etc., in breeding has not

come into vogue in this country. Researches on modern lines have, however, been taken up only recently at the Imperial Agricultural Research Institute and already results of promise are indicated. Isolated experiments in productive genetics are also being made in a few other centres but much more remains to be done. If we are to advance in the future with regard to the solution of our varied problems in crop production, we have to bring into being a vastly expanded and co-ordinated plan of active research in pure and applied plant genetics whereby the breeding material and methods at our disposal could be enriched for exploitation by the breeder. The following are a few suggestions for the organisation of genetic research in India.

Some Suggestions for the Future Organisation of Genetic Research in India

The entire programme of work in connection with the improvement of crops in so far as it relates to breeding by genetical methods, may be divided into (1) Long-range research for discovering material, principles and techniques for breeding; and for training geneticists, (2) breeding for yield and other qualities in crops and (3) testing, multiplication, certification and distribution of bred varieties.

1. *Long-range Research.*—The long-range research should be located in the Central Research Institute, whose functions will be roughly as follows:—

(*i*) The survey and collection of the economic plant material including allied species of cultivated plants in the country and their systematic analysis with regard to their inherent useful qualities, their capacity to transmit them when crossed and the working out of techniques for obtaining such crosses for utilization in breeding. The work of the survey may be vested in a Bureau of Plant Introduction such as was pointed out by Dr. Pal in the Soils Wing Meeting of the Board of Agriculture, 1942, which will function as a wing of the Institute with a well-trained staff of geneticists and taxonomists. The universities may be called in to help in collecting information and material during tours of their staff and students in their respective provinces. The testing of the entire material could not, of course, be done in the main Central Institute owing to different climatic requirements of the plants and, therefore, a number of sub-stations in the different climatic zones will be needed for the purpose. The Bureau will also undertake introduction of plants from outside whenever possible. The materials accumulated and the experience gained with them will prove of great use to breeders of different crops situated in different localities.

(*ii*) Fundamental genetic research for discovering the best techniques connected with breeding of the different types of crops such as self-fertilized, cross-fertilized and vegetatively propagated ones and evolution of new principles and methods discovered elsewhere for application to Indian conditions and crops.

(*iii*) Breeding of special crops and for special requirements for which the Central Research Institute is best fitted by virtue of its well-equipped laboratories and staff, as for instance, the breeding of potatoes and disease-resistant wheats.

(*iv*) Training post-graduate students in genetics and plant breeding. The Central Research Institute should be the best place for giving such training as it will be in touch with high-class fundamental research. For the training to be effective, it is necessary for the universities to devote more attention to the teaching of genetics, which unfortunately at present, is not receiving the attention it should. It is indeed a sad state of affairs that none of the many universities in India has a chair of genetics.

2. *Breeding Stations.*—For breeding superior strains of crops with required qualities, one or more breeding stations for each commodity may be set up in the areas typical for those crops. Each station, besides the other agricultural specialists; should have on its staff a well-trained geneticist who will help in the formulation and conduct of the breeding experiments. The breeding stations will work in collaboration with the Central Research Institute and will derive help from the latter both in regard to breeding material and techniques.

3. *Testing Stations.*—Small testing stations attached to each of the commodity breeding stations may be set up with a limited staff of agronomists and breeders to test out the bred varieties for their suitability to the different areas. At the testing stations, the potentiality of the different strains to respond to cultural and manurial treatments will also be tested. Multiplication, certification and distribution of approved seeds may also be supervised by the staff which may include a pathologist and an entomologist.

The above are only a few suggestions which may provide some basis for the organization of genetic research for improving crop production in this country. The question as to how the entire organisation should be secured and controlled is a matter for administrative authorities to decide.

S. Ramanujam.

PROFESSOR SUBRAMANYA CHANDRASEKHAR, F.R.S.

NOT a few Indian intellectuals have found a congenial home in the United States of America and are engaged in scientific or industrial pursuits with great credit to themselves and to the land that gave them birth. Amongst these, by far the best-known internationally is the young Indian who holds the Chair of Theoretical Astronomy and Astrophysics at the Yerkes Observatory of the University of Chicago. The very high estimate in which Dr. Chandrasekhar is held by his colleagues at Yerkes Observatory and by American astronomers generally was demonstrated in practical fashion by his recent promotion from an associate to a full professorship in the University. He has already built up around himself a strong school of young American investigators, and the place he has made for himself is being increasingly recognised as one indispensable for the progress of astronomy in his country of adoption.

Professor Chandrasekhar is only 33 years of age. His election to the Fellowship of the Royal Society announced in a recent message of Reuter from London is one of the series of notable academic and scientific distinctions he has already achieved. As in the case of the late Mr. Ramanujam, the F.R.S. was preceded by the distinction—unique for an Indian—of the Fellowship of Trinity College at Cambridge. Last year, the New York Academy of Sciences crowned his work on stellar dynamics by the award of a coveted prize. A list of the Universities and of the learned societies in Europe and America which have honoured Chandrasekhar by an invitation to lecture before them and shown their appreciation of his contributions in one way or other would be a lengthy document. The Harvard University was one of these, and the lecture course he delivered at that great centre of learning resulted in an invitation to join the staff of its well-known astronomical observatory. Chandrasekhar, however, preferred the position he now occupies at Chicago, in view of the opportunities which the chair gives him of being in constant contact with the work of an active group of astronomers at a number of observatories including that at Yerkes.

Dr. Chandrasekhar's publications cover many aspects of Astronomy and Astrophysics. During his Cambridge period, his papers appeared for the greater part in the *Proceedings of the Royal Society* of London and the *Monthly Notices of the Royal Astronomical Society*. After he went to Chicago the papers by himself and his collaborators are a regular feature in the *Astrophysical Journal*. A complete bibliography of these would include over eighty titles. Special mention should be made of three major treatises which Dr. Chandrasekhar has written during recent years, and in which the interested reader can find an exposition of his ideas and contributions. The first book entitled "An Introduction to the Study of Stellar Structure" was published in 1939 as one of the series of Astrophysical Monographs issued by the University of Chicago Press. This treats in a deductive manner the subject of stellar interiors, the necessary physical theories and mathematical methods being fully explained. The treatise includes accounts of the foundations of thermodynamics, the theory of radiation, the quantum theory of a perfect gas, and a discussion of the elements of nuclear physics. The whole subject is presented with enviable crispness and clarity of expression. The second treatise entitled "The Principles of Stellar Dynamics" appeared in the same series in 1942. In this monograph the dynamical methods of interpreting the motions in the galaxy, spiral nebulæ, and star clusters are developed from a coherent point of view. An American astronomer reviewing this treatise remarked that it should exert a profound influence on the future developments in the field of galactic dynamics. The third monograph by Dr. Chandrasekhar entitled "Stochastic Problems in Physics and Astronomy" was published by the American Physical Society in the *Reviews of Modern Physics*. The analogies which exist between the movements in star clusters and the Brownian movements in colloids are here developed and expounded in an interesting way.

Chandrasekhar is one of that small rare group of men who combine a profound grasp of physical theory and principles, an unrivalled grasp of the methods of mathematical analysis, and a deep and abiding interest in the phenomena presented to us by Nature in the fields of Physics and Astronomy. The names of Newton, Laplace and Einstein spring to the mind when we contemplate the past history of astronomical science and its debt to men who have exhibited this combination of qualities. In the achievements of Chandrasekhar during the past fifteen years, we have at least the promise of a career which should place him in the front rank of the world's great astronomers. The cordial good wishes of all our readers will go out to encourage him in his future activities and to wish him and the talented young Indian lady who shares his home at Yerkes Observatory an uninterrupted welfare and happiness.

GLANDS AND GLAND PRODUCTS

II. The Persulphate Colour Reaction for Adrenaline

BY
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(Department of Chemistry, Presidency College, Madras)

A RELIABLE and rapid colorimetric method for the estimation of adrenaline which would be applicable not only to pure solutions but also to gland extracts and concentrates had to be chosen in the course of our investigations on the isolation of this hormone from the suprarenal glands of animals. The most popular method for the colorimetric estimation of adrenaline appears to have been the one based on Folin's uric acid reagent, although this method has been subjected to adverse criticism from many quarters. Numerous trials with this and other methods have now been made and our conclusion is that, of the available methods, the most accurate is the one based on oxidation with persulphate or with iodine.

TABLE I

Nature of gland	Time for maximum colour development (in hours)	Adrenaline content (mg. per g. of fresh gland)	
		Persulphate method	Iodine method
Cattle	2½	1·82 1·90	1·84 1·90
Sheep	2½	1·56 1·58	1·65 1·68
Pig	2	0·82 0·74	0·90 0·76

TABLE II

Effect of added substances on the time taken for maximum colour development

(a) Substances which do not inhibit development of colour

Nature of Substance	Amount of substance added in mg.	Effect
Trichloracetic acid ..	5–10 mg.	No inhibitory effect
Phenol	0·170 ,,	do.
Resorcinol	0·168 ,,	do.
Glucose	0·210 ,,	do.
Cane sugar	0·126 ,,	do.
Ascorbic acid	0·140 ,,	do.
Uric acid	0·107 ,,	do.
Sodium stearate ..	0·230 ,,	do.
Sodium palmitate ..	0·205 ,,	do.
Tartaric acid	0·170 ,,	do.
Tryptophane	0·172 ,,	do.
Arginine hydrochloride ..	0·200 ,,	do.
Glutamic acid	0·200 ,,	do.
Glycine	0·208 ,,	do.
Tyrosine	0·150 ,,	do.
Alanine	0·170 ,,	do.

(b) Substances which inhibit colour development

		Period for maximum colour development (in minutes)
Histidine hydrochloride	0·146 mg.	75
Cystine	(1) 0·09 ,, (2) 0·15 ,,	150 280
Thioglycollic acid ..	(1) 0·12 ,, (2) 0·16 ,, (3) 0·64 ,,	15 25 95
Glutathione ..	(1) 0·038 ,, (2) 0·077 ,, (3) 0·115 ,, (4) 0·192 ,, (5) 0·384 ,,	20 35 55 95 165
Cysteine hydrochloride	(1) 0·029 ,, (2) 0·083 ,, (3) 0·166 ,, (4) 0·332 ,,	40 80 140 270
Trichloroacetic acid extract of pituitary glands	Corresponding to 0·2 g. of fresh glands	45
Blood filtrate (protein-free)	½ c.c.	45

The persulphate colour reaction, discovered by Ewins, was developed by Barker and others[1] into a colorimetric method where the adrenaline content of gland extracts was assayed by treatment of the extract with persulphate reagent at pH 5·4, the maximum colour intensity being evaluated with the aid of a Tintometer and the adrenaline determined by comparison with a standard solution of Adrenaline treated in the same way. Schild[2] first made the interesting observation that the colour development was extremely slow in the case of gland extracts, so that the possibility of direct comparison against standard adrenaline solutions using a colorimeter was practically ruled out. Schild obtained reliable results only by reading off the maximum red tinge with a tintometer. The persulphate colour reaction was also critically examined by Devine[3] who found that ox adrenals developed the maximum colour at the end of 2½ hours while horse adrenals required nearly 6 hours,

Rees,[4] who confirmed the observations of Schild and Devine regarding the slow development of colour in gland extracts, showed that in spite of this defect reliable results could be obtained using a tintometer by a proper adjustment of pH and temperature.

According to our own experience of this method, the maximum colour intensity with the persulphate reagent under conditions specified by Barker and others (*loc. cit.*) is reached at the end of 2 to 2½ hours in the case of gland extracts (cattle, sheep and pig glands), and in ten to twenty minutes with pure adrenaline solutions. The estimations have, however, been successfully carried out, using an ordinary Duboscq colorimeter for comparing the two colours, by a slight modification of the usual procedure. The colour of the gland extract is allowed to develop first and thirty minutes before the maximum is reached, the time for maximum colour being determined separately in preliminary experiments, the development of the standard colour is started, the comparisons being made at the end of the period. The matching under these conditions is perfect and the results are not only easily reproducible, but also compare very favourably with those obtained by the iodine oxidation method. In the latter method the colour development occurs normally even in the case of gland extracts. The results are illustrated in Table I. Systematic attempts were then made to discover the nature of the particular substance or substances which could be responsible for the retardation of the colour development with the persulphate reagent. As trichloracetic acid extracts of glands were employed, they should be considered to be protein-free. The method adopted was the addition of known amounts of various pure compounds and also tissue extracts to standard adrenaline solutions containing about 0·2 to 0·3 mg. of the free base and determination of the time taken for the maximum development of colour. The results are represented in Table II.

The observation that glutathione and cysteine, both of which contain the sulphydryl group, exert a marked retarding effect on the colour development is very significant in view of the known fact that the adrenals contain the richest concentration of glutathione in the animal body. The interference due to cysteine is rather difficult to explain unless perhaps one assumes that reduction to cysteine is taking place under the conditions of experiment, or that it gets preferentially oxidised. Very interesting also is the observation that trichloracetic acid extracts of pituitary glands have a similar effect on the retardation of colour development. It will be recalled that ascorbic acid determinations in this gland, as in the case also of the adrenal glands, by the indophenol titration method yield consistently lower values than by the iodine titration method, thereby indicating the presence of extraneous reducing systems both in the adrenal and the pituitary glands.

The expenses of these investigations were met entirely by a grant from the Board of Scientific and Industrial Research, to whom our grateful thanks are due.

Further investigation is progressing.

1. Barker, Eastland and Evers, *Biochem. J.*, 1932, **26**, 2129. 2. Schild, *J. Physiol.*, 1933, **79**, 455. 3. Devine, *Biochem. J.*, 1936, **30**, 1769. 4. Rees, *Quart. J. Pharm.*, 1936, **9**, 659.

NOMENCLATURE OF POSTERIOR FINS OF FISHES

By JNANENDRA LAL BHADURI
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THE term 'ventrals' is well known in ichthyological literature, but, having gained access to text-books, it has become rather confusing to the general students of zoology. It is found that many authors do not hold the same opinion in regard to the proper use of the term. A few random instances from several well-known text-books will show that while some authors[1] use ventral fin and anal fin as synonyms, others[2] use 'ventrals' for the paired pelvic fins. A few authors,[3] however, avoid the use of the term 'ventrals', and write only the unequivocal terms 'pelvics' and 'anals'. Further, reference to Indian ichthyological works[4] will show that 'ventrals' was chiefly, if not exclusively, used as a synonym for 'pelvics'.

Synonymous terms are indeed sometimes confusing, but we know that they are rampant in all literature, and it is by no means easy to repudiate them. Having due regard to comparative anatomy of vertebrates, it is exhorted that 'ventrals' should never be used for 'pelvics', since it is well known that pelvic fins of fishes are paired, and, as such, go to form the pelvic girdle and limbs of tetrapods, and in groups higher than fishes, 'ventrals' is never used in that sense. In the review of Thillayampalam's second edition of *Scoliodon*, Dr. Hora[5] raised this point, but did not resolve it. I invited his attention to the above farraginous use of the term 'ventrals', and Dr. Hora, in a letter (April 1939) kindly replied as follows:—

> "The British Museum ichthyologists use 'pelvic fins' and not 'ventral fins' for the hinder paired fins. I have not paid much attention to these terms so far, but on reading your letter I would be inclined to follow the British Museum people. I think you have made out a very good case for the use of the term pelvic fins. I am further of the opinion that 'ventral fin' should not be used for the anal fin, otherwise there may be some confusion."

I had also received the opinions of four other eminent zoologists, namely, the late Dr. C. Tate Regan, F.R.S., Director, British Museum (*Nat. Hist.*), London, Prof. E. S. Goodrich, F.R.S., of Oxford University, Prof. L. F. de Beaufort, of the Zoological Museum, Amsterdam, and

Dr. E. W. Gudger, Ph.D., Honorary Associate, American Museum of Natural History, New York. I take this opportunity of recording my deep sense of gratefulness to all of them for their cordial and considered expression of opinion. The points on which information was sought of them may be summarised as follows, *viz.*, (*a*) whether the term 'ventrals' should be used as a synonym for either 'pelvics' or 'anals'; if not, should it be retained in the descriptive morphology of fishes; (*b*) what are the etymological and morphological significance of the term 'ventral'? The replies I received from them being informative, I am tempted to quote them *in extenso*.

Dr. Tate Regan wrote on April 25, 1939:—

"The words vent and ventrals are not related. Ventral—pertaining to the belly (Lat. *venter*, belly) as dorsal means pertaining to the back. In descriptive zoology these meanings are somewhat extended, so that dorsal and ventral are equivalent to upper and lower.

"The word ventral might thus be used for any of the lower fins, but I myself, finding it used by some authors for one fin, by others for another, thought it best to give it up altogether, especially as there are names available, pelvic and anal, about which there is no doubt."

Prof. Goodrich wrote on July 20, 1939:—

"The term 'ventral' is derived from the Latin *venter* = belly and is used as opposed to dorsal. Very generally in the older literature the pelvic fins were designated as 'ventrals', but it is a bad term for this purpose and they should certainly be called pelvic fins. So far as I can remember I have always used 'pelvic' myself—though I see that in your letter you put my name among those who have used 'ventral fin' as well. If so it must have been by mistake—a slip of the pen.

"The term 'anal' is correct for the median fin behind the anus.

"Of course both the pelvics and the anals are ventral in a general sense."

Prof. de Beaufort wrote on May 2, 1939:—

" ..... The question is this. The ancient authors called the ventrals 'Pinnæ ventrales' and this has been translated in all languages as 'ventrals' or their synonym. I think it was Regan who pointed out that this name is not correct, as in many fishes the ventrals are not ventral, but thoracic or even jugular. He, therefore, used the name 'pelvics'. I think this is a better neutral name, but I am too old-fashioned to change my habits and I still use 'ventrals'. The principal reason is, that in the work edited by me and the late Prof. Max Weber, we used the term 'ventrals' from the beginning and it is difficult to change to another name in following volumes. I hope to have answered your question satisfactorily and if you will have my advice I should say, use the term pelvics."

Dr. Gudger wrote on May 5, 1939:—

"The question raised in your letter of April 13th is one that I have raised very frequently in discussion with ichthyologists. We agree and so do the comparative anatomists that the anterior paired fins of a fish should be called pectorals, being directly homologs with the pectoral arch and anterior limbs of the higher vertebrates.

"Unfortunately there is great discrepancy with regard to the posterior girdle and fins. The comparative anatomists, of whom the late James S. Kingsley is one, have always contended so far as I know that the posterior girdle and fin should be called pelvic. This is logical since they are the homologs of the hinder girdle and limbs of the higher vertebrates.

"This is the practice of the Cambridge Natural History, of J. Graham Kerr in his text-book of embryology, and many other men. The new Webster International Dictionary, second edition, uses pectoral and pelvic fins. I was editor for the ichthyological terms of this second revisal and I saw to it that this usage was made in the dictionary.

"The fin or fins on the back of a fish are, of course, plainly called dorsals. The fin at the vent is and probably correctly called anal but this is certainly an anomaly with the second fin of this kind, as in the cod-fish, when it is called the second anal in the books. Probably it would be better usage to call both these fins ventrals but anal is well established and if ichthyologists can be persuaded to call the hinder paired fins pelvics, then it might be possible to designate this second so called anal in codfish as a ventral fin. The trouble about calling these two unpaired fins ventrals is that neither one of them is on the venter or belly.

"The long and short of the matter is that the hinder girdle and paired fins should be called pelvic. We are there on solid morphological grounds.

"I hope that this dissertation may be of some value to you."

It will be seen from the above that there is no division of opinion in discarding the term 'ventrals' in favour of 'pelvics'; even Prof. de Beaufort endorses the same view, although he himself is unable to follow it up for reasons best stated in his letter. But, from the recent writings of Dr. Hora,[6] it will be noticed that although he is not desirous of using 'ventrals', he occasionally employs both the terms 'ventrals' and 'pelvics' in a synonymous sense.

Apropos of the ventrals being used as a synonym for the 'anals', there seems to be some difference of opinion. Prof. de Beaufort does not appear to have written anything about this, while Prof. Goodrich's last statement expresses that the term 'ventrals' may be retained in a general sense for both 'pelvics' and 'anals'. On the other hand, Dr. Gudger seems to be somewhat dubious about this point, and cannot arrive at a definite conclusion. Dr. Regan is, however, very clear about this issue, since he has long steered clear of 'ventrals'. Dr. Hora is also of the same opinion. I am not aware of what other ichthyologists think about these contentions.

Attention may also be drawn, in this connection, to another fact which Dr. Hora has kindly pointed out to me. It is the usual prac-

tice with the ichthyological systematists to write the fin-formula as 'D.P.V.A.C.', where 'V' stands presumably for 'ventrals'. Those who have discarded the term 'ventrals', retain, however, the symbol 'V.' for pelvics in the fin-formula. Systematists should also ponder over this abbreviation.

In fine, I am inclined to follow Regan's views and ask for a complete banishment of the term 'ventrals' from the description of ichthyological morphology, notwithstanding that this term has found frequent currency since the dawn of ichthyological science down to this day. It is hoped, and urged, that ichthyologists should give a unanimous verdict on the stringent use of the term 'ventrals' so that text-book authors may give currency to a correct and unconfounding term for the profit of general students of zoology.

1. Bourne, G. C., *Comp. Anat. Animals*, 1922, **2**, 206–7; Wiedersheim, R., and Parker, W. H., *Comp. Anat. Vertebrates*, 1907, p. 136; Thillayampalam, E. M., *Scoliodon*, 1938, p. 16; Thomson, J. A., *Outlines of Zoology*, 1929, p. 631; de Beer, G. R., *Vertebrate Zoology*, 1932, p. 80; Newman, H. H., *The Phylum Chordata*, 1939, p. 148; Wheeler, W. F., *Text-book of Zoology*, 1938, p. 109; Walter, H. E., *Biology of the Vertebrates*, 1939, pp. 600, 617; Parker, T. J., and Haswell, W. A., *Text-book of Zoology*, 1940, **2**, 238; Hyman, L. H., *Lab. Manual for Comp. Vert. Anat.*, 1940, p. 20. 2. Günther, A. C. L. G., *An Intr. to the Study of Fishes*, 1880, p. 42; Nicholson, H. A., *A Manual of Zoology*, 1887, p 634; Jordan, D. S., *Fishes*, 1925, p. 23; Kingsley, J. S., *The Vertebrate Skeleton*, 1925, p. 227; Sedgwick, A.,* *A Student's Text book of Zoology*, 1905, **2**, 185; Goodrich, E. S.,* *Studies on the Structure and Development of Vertebrates*, 1930, p. 123; Wolcott, R. H., *Animal Biology*, 1940, p. 354; Innes, W. T., *Exotic Aquarium Fishes*, 1938, p. 81. 3. Dakin, W. J., *The Elements of Biology*, 1934, p. 177; Kerr, J. G., *Zoology for Medical Students*, 1921, p. 294; Chidester, F. E., *Zoology*, 1933, p. 252. 4, Day, F., *Fauna Brit. India*, 1889 and *Fishes of India*, 1878–88; Annandale, N., Chowdhury, B. L., Hora, S. L., and others, *Rec. Ind. Mus.*, 1910–38. 5. *Curr. Sci.*, 1939, **8**, 135. 6. *Rec. Ind. Mus*, 1940–42.

* The authors point out either in parentheses or in footnotes as 'often or usually called ventrals', otherwise they use 'pelvics' exclusively.

RAO BAHADUR K. N. DIKSHIT, M.A. F.R.A.S.B.

RAO BAHADUR K. N. DIKSHIT who will be retiring shortly from the post of Director-General of Archæology in India was appointed to that post in 1937. Before he became Director-General, he had gained wide experience in various capacities as Superintendent of Archæology in the Indian Museum and in several provinces, as Government Epigraphist, and as Deputy Director-General. He was one of Sir John Marshall's collaborators in the well-khown excavations at Mohenjodaro. His contributions in the field of epigraphy, numismatics, ancient Indian art, etc., are well known and too numerous to be referred to here (for details *see* O.C. Gangoly, *Modern Review*, February, 1944, pp. 124-126). Few of the readers of *Current Science* would have missed his popular papers, such as *The Outlines of Archæology* or *The Progress of Archæology in India during the last 25 years* (both published by the Indian Science Congress Association, 1938) or his Sir William Meyer Lectures on the Prehistoric Civilization of the Indus Valley. The Paharpur mounds in E. Bengal which he excavated brought to light one of the most important and large-sized temples decorated with numerous terracotta plaques of the Gupta and medieval periods. For the last three years Mr. Dikshit has been concentrating attention on the excavations at Ahicchatra in Bareilly District (U.P.), where discoveries of fundamental importance have been made, particularly of pottery, that will help in establishing the relative chronological sequence for most North Indian historical sites. The large-sized terracotta plaques found at Ahicchatra, with those of Paharpur, have revealed a new school of art in burnt clay.

Rao Bahadur Dikshit has done yeoman service to Archæology in India in several directions by helping and encouraging archæologists in Indian States and the Provinces. He revived the system of Archæological scholarships under the Government of India and induced Indian States to institute similar scholarships, and helped the starting of such organizations as the Kannada Research Society at Dharwar and the prehistoric research expedition in Gujarat. In fact he was indefatigable in his attempts to extend archæological knowledge, the veriest novice finding in him a sympathetic and helpful friend. The Archæological Society of South India received the warmest support from him. By stimulating the free exchange and distribution of antiquities between the museums under the control of the Central Government on the one hand and Provincial Governments on the other, Rao Bahadur Dikshit helped to break the provincialism that always threatens to invade Museums, and there is no exaggeration in stating categorically that there are no Indian museums that have not directly or indirectly benefited by his interest in the Museum movement. Extremely genial in temperament and by nature a good miker, Rao Bahadur Dikshit has been popular everywhere, no matter whether it was a meeting of the Indian Science Congress, the Oriental Conference, the Indian Historical Congress, etc., or an excavation camp ; he always attracted men to him. His numerous friends in India and abroad would wish Rao Bahadur Dikshit rest and respite from the " spade ", and administrative duties but they will continue to be keen on having more from his mature and scholarly pen. He has still both physical and mental vigour which would, we hope, be long available in the service of the subject for which he has already done much.

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DIRECT DERIVATION OF BALMER SPECTRA

Bohr's attractive planetary model, and the simplicity of his derivation of the Balmer series still hold a place in theoretical physics, in spite of the palpable contradictions of the model, differences from fine-structure experimental work, and later theoretical discoveries. It would seem worth while to attempt a direct approach to the problem.

The mechanism by which the electron absorbs the energy of a photon or emits a photon of energy is not satisfactorily explained. But it is generally taken for granted that electromagnetic phenomena are governed by the Lorentz group, so that energy has to be measured by the relativistic formula

$$E=\mu/\sqrt{(1-v^2/c^2)}.$$

On the other hand, electrons in thermionic or in photo-electric emission are assigned the usual Newtonian mass-energy $mv^2/2$, m being the mass, and v the same velocity as in the other formula. This is considered necessary in view of the fact that the emitted electrons seem to follow the Maxwellian (normal) velocity distribution. In what follows, I work out the consequences of this double interpretation of energy and show that the Balmer series formula is an immediate consequence.

The basic formula used will have to be

$$E=h\nu-P=\frac{h\,[n-p]}{2\pi},\ (n \text{ an integer}), \quad (1)$$

where ν is the frequency in *sec.*$^{-1}$, of the exciter wave which has the formula, say, $A\sin nt$, h being Planck's constant as usual and P the *Austrittsarbeit* term supplied by Einstein; instead of restricting it to a metallic surface, however, we shall have to assume that the term accounts for a certain amount of energy which disappears at the surface of any system, even an atomic one, in photo-electric interaction.

The next step is to assume that this is absorbed according to the Lorentz-Einstein law, *i.e.*,

$$\frac{h\,[n-p]}{2\pi}=\frac{\mu}{\sqrt{1-v^2/c^2}}, \quad (2)$$

where μ is an unspecified constant of the absorbing system. This gives at once,

$$v^2=c^2-\frac{4\pi^2\mu^2c^2}{h^2\,(n-p)^2} \text{ whence}$$

$$\frac{mv^2}{2}=\frac{mc^2}{2}-\frac{2\pi^2m\mu^2c^2}{h^2\,(n-p)^2} \quad (3)$$

This $mv^2/2$ term, with m the mass of the electron, will now be assumed to account for the energy between levels, so that if a wave is emitted with the frequency ν, then $h\nu$ will be the energy difference; that is,

$$h\nu=\frac{2\pi^2m\mu^2c^2}{h^3c}\left\{\frac{1}{(n_1-p_1)^2}-\frac{1}{(n_2-p_2)^2}\right\};$$

$$\nu=\frac{2\pi^2m\mu^2c}{h^3}\left\{\frac{1}{(n_1-p_1)^2}-\frac{1}{(n_2-p_2)^2}\right\}, \quad (4)$$

where the extra divisor c (= velocity of light) has appeared on the right because we assume this frequency ν to be measured, as usual in spectrometry, in *cm.*$^{-1}$, and not *sec.*$^{-1}$. It remains only to note that we get the usual Rydberg constant on the right if we identify the coefficient μ with ze^2/c, where e is the

charge of the electron, and z the factor for nuclear charge. Thus, the Balmer formula is derivable as a property of Planck's law, and the ambivalent measurement of energy, without any assumption as to the planetary structure of the atom. In addition, we get the fine-structure terms without further trouble. On the other hand, an assumption of some sort will have to be made about atomic structure or its field of probabilities, in order to derive the intensities.

Fergusson College,
Poona 4, D. D. KOSAMBI.
March 3, 1944.

STRUCTURE OF THE SECOND SPARK SPECTRUM OF BROMINE—BR III

QUARTET and Doublet terms of Br III were reported in a previous communication.[1] A further investigation of the spectrum has led to the identification of many intercombination lines in the ordinary optical and vacuum grating region. The interval between the deep terms $4p\ ^4S_{3/2}$ and $4p\ ^2D_{3/2}$ is found to be 15042 units and that between $4p\ ^2D_{5/2}$ and $4p\ ^2P_{1/2}$ is 10613. The ratio between the intervals is in agreement with the theoretical value. A full report of the extension of the scheme of terms will be published elsewhere.

Andhra University,
Guntur, K. R. RAO.
February 18, 1944.

1. Rao and Krishnamurty, *Proc. Roy. Soc.* (Lond.), **1937, 161,** 38.

THERMAL REPULSION

DURING the last few years numerous contributions,[1,2,3,4,5] have been made to this subject from the laboratories of the Meteorological Office at Poona. It was shown[4,5] that, under the ideal conditions when convective movements are eliminated in an air-cell by bringing the plane hot surface sufficiently close to the plane cold surface, the thermal repulsion of objects like dust particles, oil droplets or a mica vane (suspended vertically by quartz fibre and at right angles to the temperature gradient) may be observed as a simple force acting in the direction of the thermal gradient towards the cold surface. Under the above circumstances, the thermal force is not affected by the disturbing influence of convection. A reference to the figures in Plate XI of Paranjape's paper[4] will show the simplicity of the phenomenon when convection is eliminated.

Fig. 1 shows the apparatus devised by Ramdas and Joglekar[5] for measuring the force due to thermal repulsion. A temperature gradient is maintained between the faces GH and KL of the vessels A and B which are kept at the desired temperature by circulating hot and cold water respectively through the tubes C_1, C_2 and C_3, C_4. T_1 and T_2 are thermometers. The vessels A and B slide in the outer piece CEFD so that the distance between GH and KL may be adjusted as desired. The joints at C, D, E and F can be made air-tight by means of a mixture of bees-wax and rosin. The mica piece M is suspended by means of a fine

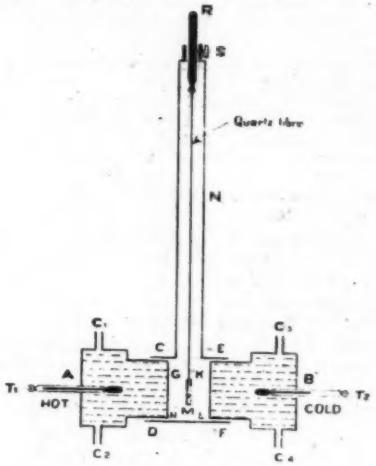

FIG. 1.

quartz fibre as shown. As soon as the face GH becomes warmer than KL, M is deflected to the right, the deflection being proportional to the thermal gradient. The deflections are measured by means of a microscope focussed on the lower end of the quartz fibre and having a suitable graticule in the eye-piece.

At the suggestion of Dr. Ramdas, the present writer undertook the investigation of the effect of the pressure of the gas on thermal repulsion. The range of pressure was from .1 atmosphere down to the lowest pressure which it was possible to obtain with a high-vac pump in series with a pair of Waran's mercury diffusion pumps, with the necessary traps to eliminate water vapour. The low pressures were measured by a Mac-Leod gauge and the higher pressures directly with the aid of a travelling microscope and a mercury manometer.

It is found that the thermal repulsion pressure F ($F = mg\theta$ where m is the mass per unit area of M the mica-piece, θ is the angular displacement from the vertical in radian measure and g is the acceleration due to gravity) is found to increase only slightly on reducing the pressure in the apparatus from 71 cm. to 1 cm. of Hg. The most interesting variations occur as the pressure is reduced below 1 cm. There is at first a gradual and later a very rapid increase in the thermal force. For an air gap of 2·5 mm. and a temperature difference of 2·5° C. between the walls (under the ideal conditions referred to at the beginning of this note, relatively small temperature gradients are indeed sufficient to produce sensible effects) the thermal force for a temperature difference of 1° C. attains a maximum value of the order of 0·027 dyne per sq. cm., when the pressure is about 10^{-2} cm. of Hg. As the pressure is reduced further the thermal force decreases rapidly. Fig. 2 shows the general nature of the results obtained. It may be pointed out that the portion BC of the curve

represents conditions corresponding to the "Knudsen manometer action" which is utilised for low pressure measurements (Pirani

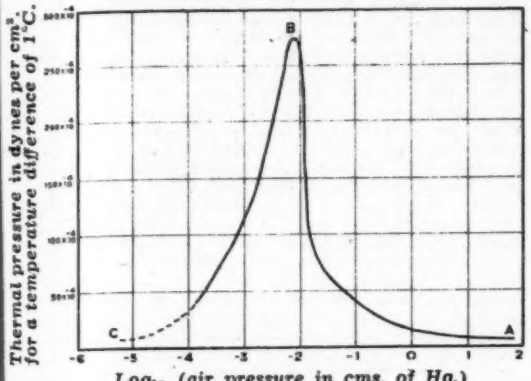

FIG. 2

Gauge*). Curves somewhat resembling Fig. 2 were obtained by G. D. West[6] but his experimental arrangements and results were complicated by the use of rather large-sized air-cells and of radiation as the source of heating.

The whole subject is now under active investigation for different air-gaps, temperature gradients and gases. A full discussion of the results, both experimental and theoretical, will be presented in a forthcoming paper.

The writer is grateful to Dr. L. A. Ramdas, Agricultural Meteorologist, for suggesting the problem and for guidance. Thanks are also due to the Director-General of Observatories for permission to work in the laboratories of the Meteorological Office at Poona.

Meteorological Office,
Poona, M. K. PARANJAPE.
February 18, 1944. Lecturer in Physics,
Sir Parasuram Bhau College.

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1. Ramdas, L. A., and Malurkar, S. L., *Ind. Journal of Physics*, **1932**, **1**, 1. 2. —, *Nature*, February, 1932, **6**, 201. 3. Ramdas, L. A., *The Journal of the University of Bombay*, Sept. 1937, **6**, Pt. II, 18. 4. Paranjape, M. K., *Proc. of the Ind. Academy of Sciences*, 1936, **4A**, 4, 423. 5. Ramdas, L. A., and Joglekar, S. Y., *Ibid.*, 1941, **13**, No. 5, Sec. A. 6. West, G. D., *Proc. Phys. Soc.*, London, 1920–21, **33**, 266.

* See also a paper by Lockenvitz; *Review of Scientific Instruments*, 1938, **9**.

HUMID FATIGUE OF HYGROMETERS

Now, while finding the time lag of Mahajan's optical hygrometer,* it is observed that this hygrometer when treated for a number of times with moist and dry currents of air alternately (without any break in the cycle of observations) has less time lag than otherwise. The hygrometer which has been so treated comes to rest and gives a constant value in a shorter time than otherwise. Thus the time lag of hygrometer depends upon its immediate past history, besides other factors.

The effect of the immediate past history is found in other types of hygrometers also. This phenomenon may be called the Humid Fatigue of hygrometers.

A set of observations recorded for some of the hygrometers is given in Table I below.

TABLE I

Kind of hygrometer	No. of observations	I cycle		II cycle		Remarks
		Increase of humidity	Decrease of humidity	Increase of humidity	Decrease of humidity	
1	2	3	4	5	6	7
Mahajan's Optical Hygrometer	1st set	22 min.	37 min.	21 min.	34 min.	All sets taken on different days & times
	2nd ,,	20 ,,	38 ,,	15 ,,	30 ,,	
	3rd ,,	18 ,,	34 ,,	11 ,,	23 ,,	
	Mean	20 ,,	36 ,,	16 ,,	29 ,,	
Hair Hygrometer	1st set	20 min.	40 min.	17 min.	29 min.	do.
	2nd ,,	17 ,,	39 ,,	16 ,,	27 ,,	,,
	3rd ,,	18 ,,	38 ,,	15 ,,	25 ,,	,,
	Mean	18 ,,	39 ,,	16 ,,	27 ,,	
Paper Hygrometer	1st set	35 min.	45 min.	22 min.	32 min.	do
	2nd ,,	29 ,,	43 ,,	25 ,,	39 ,,	,,
	3rd ,,	34 ,,	48 ,,	21 ,,	35 ,,	,,
	Mean	33 ,,	45 ,,	23 ,,	35 ,,	

In the above table, column No. 3 gives time lag when hygrometer is treated with a current of moist air, and column No. 4 represents time lag when it is merely exposed to dry air of the room (hence longer time lag in the latter case). Then just after this, the second cycle of action is repeated in the same way, and its observations are recorded in columns Nos. 5 and 6. This data clearly indicates that the time lags in the second cycle are less than corresponding time lags in the first cycle.

Physics Research Laboratory,
Mahendra College,
Patiala, L. D. MAHAJAN.
November 18, 1943.

* L. D. Mahajan, "An Optical Hygrometer", *Current Science*, Bangalore, **1941**, **9**, 2, 100, February. L. D. Mahajan, "The Optical Hygrometer and its Working," *Indian Journal of Physics*, Calcutta, Dec. **1941**, **15**, 6, 425–32.

CENTRAL HIMALAYAN GEOLOGY
A REPLY

IN a communication to the November 1943 issue of the *Current Science*, Mr. J. B. Auden raised certain questions on my recent paper on the correlation of Simla rock formations. He feels that my conclusions, based on the field study of the Sirmoor Himalayas, should not have been extended to other areas. I have only to state in this connection that the large-scale structural features in these tectonic mountains are not strictly local but have a much wider extent and may be found repeated in adjoining parts.

1. The first point raised by Mr. Auden is regarding the correlation of the Bansa Limestone with the Krols. In a table of several analyses he has tried to show that the differences are profound and as such the correlation is untenable. A perusal of the table would, however, show that the differences are not as profound as suggested but are quite within the limits of variations both lateral as well as vertical in any sedimentary formation. Moreover the differences between the Lower Krol and the Upper Krol limestones are much greater than those between the Lower Krol and the Bansa but this does not vitiate the inclusion of the former two into one Krol formation. The more important consideration in these correlations is the nature of the associated rocks which in the case of the Bansa limestone, are indistinguishable from the Simlas and the Infra Krols.

2. Regarding the nature of the Blaini boulder bed Auden states that the bed constantly occurs at a certain horizon in the Krol belt and can be traced for over 120 miles, hence has stratigraphic importance, but he omits to mention that it also occurs extensively outside this belt in association with rocks which are not members of the Krol sequence. Auden himself is not satisfied with the present conception regarding the mode of formation of this boulder bed but has failed to suggest any alternative mode. Regarding the position of the bed in my sections in the above paper I have indicated it by a line of thick dashes in Figs. 1-3 between the Infra Krols or Simlas and the Jaunsars.

Regarding the nature of the purple sandstone boulders observed in the Blaini bed their Dagshai character was recognised not by me but by officers of the G.S.I. I wonder what positive evidence Auden has to assert that they are not Dagshai but Simla or Nagthat.

3 (*a*) Regarding the occurrence of Nummulitics between the schistose rocks and Upper Tals the reference quoted by Auden is not quite clear or suggestive. But if that be true it may only indicate that the Jutogh Thrust was older than the Eocene and over a part of which, Nummulitics were deposited and later rethrusted.

(*b*) The fossiliferous limestone ascribed to Upper Tal may after all be Nummulitic and not Tal.

(*c*) Current bedding is a dubious structural feature in tectonically disturbed rocks and may not be due to the particular mode of sedimentation. This would not, further, prove the uninverted nature of the Upper Tal quartzites. Moreover, I have never asserted that they are inverted.

(*d*) The lithological gradation between 'Tal' shales and quartzites is more apparent than real and no process of sedimentation can bring about the deposition of hard quartzites over soft shales. Selective silicification or metamorphism of quartzites to the exclusion of shales is also inexplicable. Only thrust movements can bring about superposition of highly metamorphosed rocks over unmetamorphosed ones.

(*e*) I have seen the 'Tal' quartzites of the Koti-Dhaman area and they are highly metamorphosed. I fail to understand how Auden regards them as unmetamorphosed.

(*f*) I have not seen any remarkable lithological differences between the Tal and the Jutogh quartzites.

4. Lastly, Auden refers to the intrusive nature of Chor Granite. Along with previous workers Auden maintains that it is intrusive *in situ* into the Schists inducing contact effects on associated Palæozoic sediments. The Chor granite is everywhere surrounded by Jutogh quartzites and schists which are a highly metamorphosed set of rocks whether in the vicinity of the granite or away from it. The metamorphic effects are wholely of dynamothermal nature and show no characteristics of contact metamorphism. The inclusions of angular fragments of schists within the granite mass show not the least signs of resorption or even baking. Bands of dolomitic marble along the granite periphery are similarly unaffected. On the other hand the junction of granite with Jutoghs is marked by extreme foliation and brecciation the quartz porphyry being converted into papery schist and laminæ. Granite mass itself has assumed a gneissose structure which diminishes rather rapidly as we move away from the junction. This junction is also marked by an abundance of pegmatite and dolerite dikes. All these indicate clearly that the junction is a thrust plane along which there has been an appreciable movement of the granite mass over the Jutoghs.

It is quite possible that initially in the autochthonous regions the granites were intrusive into the Jutoghs, but they appear definitely

older than the Jaunsar-Simla formations. In the nappe zone, however, they are either thrusted over the Jutogh's or they form cores of the Jutogh folds.

In the end I have to state that my conclusions were based on the study of the Sirmoor Hills to which they are largely applicable. The extension of these views to areas outside Sirmoor is merely suggested as a possibility in view of the fact that these tectonic features are generally regional and not strictly local. Only a detailed study of any area in the light of these considerations would prove their applicability or otherwise to that area.

Department of Geology,
Andhra University,
Guntur, K. P. RODE.
January 17, 1944.

ALGAL STRUCTURES FROM THE CUDDUPAH LIMESTONES (PRE-CAMBRIAN), S. INDIA

WITH reference to the note published on this subject in the July number of *Current Science*, I should like at the very outset to correct the impression conveyed in the second para of that note, that Professor Sahni has "agreed that the structures referred to above are of plant origin". Professor Sahni's view in the matter is that "While it is possible that some of the concretion-like growths are due to *plant activity*, there is no evidence whatever of plant structure. I include here what you refer to as algal dust".

Since publishing the note the material has been further investigated and many more sections of this limestone showing these structures

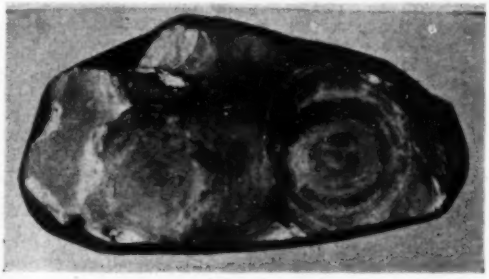


FIG. 1. Algal nodule (*cf. Cryptozoon.*) from Royalcheruvu. ×¾ (ca).

have been cut and examined. More recently I have also visited the area near Royalcheruvu, Ananthapur District, and have now been able to collect specimens of limestones showing structures remarkably similar to those described under the name 'Cryptozoon proliferum' by C. L. and M. A. Fenton,[1] from the Upper Cambrian of Pennsylvania. The rock frequently shows a number of columnar bodies of calcium carbonate tapering at one end, occurring either as free individuals or in groups when they are fused together at the bottom by horizontal or curved extensions, suggesting a colonial habit. They vary from about 1 to 2½ inches in diameter, and in a transverse view, on a polished surface of the rock, numerous irregularly concentric lines of growth can be seen; and the whole structure reveals characteristic porcellanoidal patches suggestive of algal origin. When examined under the microscope, these patches are seen to consist of aggregates of minutely crystalline calcite always having a different degree of crystallinity from the rest of the rock, and presenting a dark dusky appearance in reflected light strikingly similar to the 'algal dust' described and figured by Alan Wood[2] from the Carboniferous of England.

While it is true that definite recognisable plant-cell structures as such, have not been so far noticed, all other evidences, however, compel the author to believe that these structures are of organic origin and referable to algal activity. A full description of these structures is under preparation and will be published as early as possible.

Department of Geology,
Central College,
Bangalore, M. R. SRINIVASA RAO.
February 8, 1944.

1. C. L. and M. A. Fenton, *American Midland Naturalist*, **1937, 18, 435.** 2. Alan Wood, *Geol. Mag.*, **1941, 78, 192.**

MICROBIOLOGICAL ASSAY FOR PANTOTHENIC ACID

SINCE the discovery that the chick antidermatitis factor[1] is identical with pantothenic acid,[2,3] attempts have been made to estimate this vitamin in different biological materials. The two methods commonly used are (a) the chick growth method[4] and (b) the microbiological method employing *Lactobecillus casei*[5–8] and *Proteus morganii*[9] as the test organisms. In a previous paper[10] pantothenic acid was shown to be essential for the growth of *Lactobacellus bulgaricus*. It was felt to be of interest to discover whether this organism could be used as a test organism for the assay of pantothenic acid.

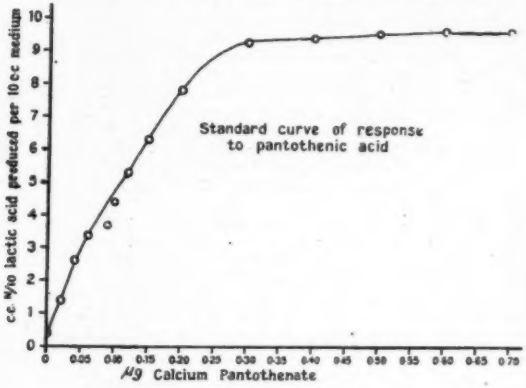
The basal medium, inoculation and the assay procedure were essentially the same as those described by Pennington *et al.*[6] The growth response of *L. bulgaricus* to different concentrations of calcium pantothenate (0·02-0·70 *µg.* per 10 c.c. medium), as determined by the amount of lactic acid formed in 72 hours at 37° C., is shown in the figure.

The values shown in the figure could be satisfactorily reproduced within a wide range (0·01-0·15 *µg.* Ca pantothenate). The curve is linear, thereby indicating the suitability of this organism for the assay of pantothenic acid.

The pantothenic acid content of samples of dried yeast, yeast extracts and animal tissues was estimated using *L. bulgaricus*. The samples, after 48 hours autolysis, were autoclaved and the extracts *thus* obtained were used at two levels for the assay. The results are presented in the table.

The reliability of the response of *L. bulgaricus* as a measure of pantothenic acid is sup-

ported by the facts that (*a*) the results calculated from two different levels agreed satisfactorily, (*b*) pantothenic acid added both to



Pantothenic Acid Content of Yeast, Yeast Extracts and Animal Tissues

Weight of test sample added to basal medium (mgs.)		μg. Ca pantothenate per gm.		% Recovery of added pantothenate	
Brewer's yeast, dried	0·4	130	133	90	90
	0·8	136		90	
Torula yeast, dried	0·4	84	84	86·7	88·4
	0·8	84		90·0	
Yeast extract (1)	0·2	290	295	107·0	103·5
	0·4	300		100·0	
" " (2)	0·2	280	282·5	—	
	0·4	285		100·0	
Alkali-treated yeast extract	0·4	0		100·0	100
	0·8	0		100·0	
Ox liver	0·4	60·0	59·5	90·0	90·0
	0·8	58·8		90·0	
Sheep kidney	0·4	26·0	28·0	90·0	
	0·8	30·0			
Sheep heart	0·4	16·0	14·5	82·0	
	0·8	13·0			

intact materials and materials in which pantothenic acid was destroyed by autoclaving with strong alkali was satisfactorily recovered, and (*c*) the values obtained are in good agreement with those reported by other workers for yeast, yeast extracts[11] and animal tissues.[12]

The method is now being extended for the estimation of pantothenic acid in other biological materials. The organism employed in this investigation was obtained from The National Collection of Type Cultures, India, Indian Institute of Science, Bangalore, to whom my thanks are due.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor, KAMALA BHAGVAT.
February 8, 1944.

1. Woolley, Waisman and Elvehjem, *J. Biol. Chem.*, **1939, 129, 673**. 2. Jukes, *J. Amer. Chem. Soc.*, 1939, **61, 975**. 3. Snell, Strong and Peterson, *J. Bact.*, 1939, **38, 293**. 4. Jukes, *J. Nutrition*, 1941, **21, 193**. 5. Pennington, Snell and Williams, *J. Biol. Chem.*, **1940, 135, 213**. 6. Pennington, Snell, Mitchell, McMahan and Williams, *Univer. Texas Publ. No. 4137*, **1941, 14**. 7. Strong, Feeney and Earle, *Ind. Eng. Chem.*, Anal. Ed., **1941, 13, 566**. 8. Landy and Dicken, *J. Lab. Clin. Med.*, **1942, 27, 1086**. 9. Pelczar and Porter, *J. Biol. Chem.*, **1941, 139, 111**. 10. Bhagvat and Sekhon, *Curr. Sci.*, **1944, 13, 45**. 11. Willerton and Cromwell, *Ind. Eng. Chem.*, Anal. Ed., **1942, 14, 603**. 12. Waisman, Henderson, McIntire and Elvehjem, *J. Nutrition*, **1942, 23, 239**.

FREEZING TEST FOR DETECTING ADULTERATION IN EDIBLE OILS

SESAME and mustard oils are generally used in this country as fat foods. To a limited degree coconut oil and nigerseed oil (kurdi oil) find popularity in certain parts of the country. Groundnut and other oils from vegetable sources such as sunflower oil, etc., are used only as adulterants for the above class. Detection of adulterations in market samples of sesame and mustard oils with the said common adulterants is a matter of considerable difficulty to the Public Analyst. The procedures leading to detection of such adulterations are tedious and require a well-equipped and staffed laboratory. In a case like the admixture of sesame oil with kurdi or kursani oil, detection is extremely difficult if not impossible in that the 'analytical constants' have the same ranges. Further the present methods detect adulteration and quantitative estimation of the components are considered far from being satisfactory. The public have no easy means to judge for themselves the market samples prior to purchase.

A few observations made by the author in the course of his work would throw some light on the question. Fresh or aged samples of genuine sesame oil and mustard oil retain their liquid consistency when cooled to the temperature of ice, whereas groundnut oil and nigerseed oil freeze to ghee-like solid at the said temperature. Mixtures of the two groups will likewise solidify at zero degree Centigrade, with this important difference that depending on the quantities of the adulterants the time taken to freeze varies. Thus it is found that if groundnut oil forms only 5 per cent. of the mixture, freezing to solid occurs in 14 hours, whereas with this component in 30 per cent. and above, brings about the same change in half an hour. In the case of nigerseed oil, for the detection of which there appears to be no method at present, freezing takes place only when it is in more than 30 per cent. in admixture. Since the procedure needs no chemicals or scientific apparatus, the test is considered very handy for the public as well as the Public Analyst.

The test itself may be performed by taking as much as a quarter ounce of the oil in a glass bottle, preferably thin-walled and kept surrounded in a container with ice broken into small fragments. If solidification takes place in less than an hour's time, it can be taken to mean that the sample is not only adulterated but that the adulterant is groundnut oil which constitutes at least 30 per cent. It is considered that the method may be improved to yield quantitative results.

Surat, G. NARASIMHAMURTHY.
January 1943.

HISTOPATHOLOGY OF NECROTIC MANGO FRUIT

In course of the investigation on the histopathological changes that occur in necrotic mango fruits certain deposits were observed in the xylem and in the ducts of the preserved diseased fruits which seemed to be casually related to the incidence of the disease.

The investigation has so far been confined to six varieties of mango fruits comprising Dashehri, Safeda, Langra, Bombai, Gola and Gola khepta, collected from various diseased and healthy orchards of Lucknow, Rampur, Fatehgarh, Mainpuri and Hardoi districts along with similar fruits from an orchard in Lucknow where experiments were carried out to initiate necrosis by fumigation by burning coal.

The mangoes utilized were healthy fruits from healthy orchards, apparently healthy fruits from heavily diseased orchards, and fruits showing different developmental stages of necrosis, both in fresh condition and those preserved for different lengths of time ranging from one day to four years in form-aceticalcohol, 90 and 70 per cent. alcohol and 4 per cent. formalin.

The technique employed were those of serial section and maceration of the tissues by means of weak solution of alkali. The maceration method by which the xylem and duct systems of the fruits could be easily traced and examined yielded better results.

Fresh healthy fruits from healthy orchards have not revealed the presence of deposits. Neither have any deposits been observed in preserved healthy fruits from healthy orchards. Apparently healthy fruits without the slightest external symptom of the disease but gathered from diseased orchards contain deposits to some extent.

The unpreserved (fresh) diseased fruits showing early stages of necrosis show deposits only in rare cases. But in mangoes showing later stages of necrosis where tissues have collapsed and disintegrated deposits are found in large quantities in the necrotic region and in ducts and vessels slightly above that region. Further beyond they seem to be free.

Preserved diseased fruits show copious deposits both in ducts and xylem elements. In vessels maximum amount of deposits (usually viscous) are found at the stalk end of the fruits most of which are completely plugged (Fig. 1). Vessels ramifying to other parts of the fruit contain deposits to a lesser degree some of which are also choked.

In ducts the deposits are particularly heavy (Fig. 2) and are present all along the system. These deposits are not continuous but are found as smaller or bigger solid or viscous masses scattered throughout the duct system.

Experiments in which the diseased fruits had been preserved in form-acetic-alcohol and 4 per cent. formalin for different lengths of time showed that the deposits become discernible on or about the seventh day. In the early period of preservation the colour of the deposits is light yellow which gradually changes into bright red as the length of preservation increases.

From a preliminary study of the chemical nature of the deposits it appears that they belong to the group of phlobatannins comparable to the deposits discovered by Dastur[1] in cotton plants in the Punjab.

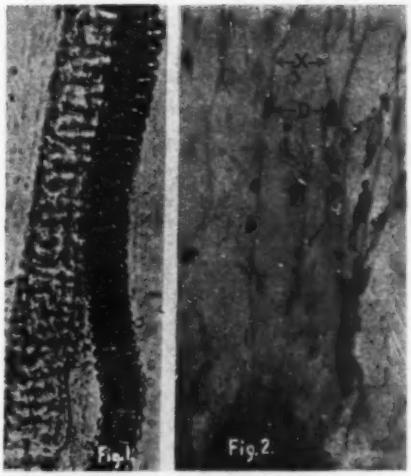


FIG. 1. Showing xylem vessel completely choked.

FIG. 2. Showing deposits (D) in the ducts and xylem (x) running along with the ducts.

It is not unlikely that in normal fruits the tannins which are formed are used up by the fruit itself. But when there are some metabolic disturbances due either to the changes in atmospheric conditions caused by fumes emanating from a brick kiln or due to other factors such as deficiency of an important element, these tannins are stored up in fruits in the form of an unutilisable tannin compound. This substance, which is probably present in a semi-solid and hyaline condition, cannot be detected without preservation. The appearance of the coloured deposits in the ducts and xylem of healthy parts of diseased fruits under preservation, however, indicates that these were present in the system and became distinguishable only when acted upon by the chemicals present in the preservatives.

The appearance of deposit is the first internal index of the disease long before the ætiolation at the distal end becomes externally visible. As the deposits increase the vessels become clogged and the supply to the distal end of the fruit is partially cut off and the disease starts. From the distribution of deposits in the ducts it seems that the deposits are translocated to the distal end where they accumulate and eventually burst the tissues. Thus the lack of supply, accumulation of deposits and consequent metabolic and histological changes bring about the diseased condition in the mango fruit.

The detailed work on the subject will be shortly published.

Botany Department,
University of Lucknow, S. N. Das Gupta.
December 21, 1943. S. N. Asthana.

1. Dastur, R. H., *Ind. Jour. Agri. Sc.*, 1941, **11**, part II.

INVESTIGATION OF PHOTOCHEMICAL AFTER-EFFECT: THE DECOMPOSITION OF HYDROGEN PEROXIDE BY POTASSIUM FERRICYANIDE

In the decomposition of hydrogen peroxide by potassium ferrocyanide or sodium nitroprusside, a pronounced after-effect of illumination has been observed by many workers.[1,2,3] From a study of the decomposition of hydrogen peroxide by potassium ferricyanide, however, Rao and Srikantan[4] have come to the conclusion that no after-effect of illumination is detectable in the reaction. On the other hand, the illuminated ferricyanide has been found by them to produce a distinctly lower rate of decompcsition than the uninsolated solution. In view of the closely related nature of ferrocyanide, nitroprusside and ferricyanide the complete absence of the photochemical after-effect in the latter appeared to us rather surprising. It was, therefore, thought desirable to investigate the decomposition of hydrogen peroxide by potassium ferricyanide in detail.

We have been able to observe a remarkably large photochemical after-effect in the decomposition of hydrogen peroxide by pre-insolated ferricyanide, particularly when some unilluminated ferrocyanide is also present in the reaction mixtures. The irradiated ferricyanide solution shows a much enhanced reactivity towards hydrogen peroxide in the dark. Furthermore, this enhanced reactivity which manifests itself as the photochemical after-effect is retained for a long time, although after irradiation it continues to diminish gradually on standing in the dark.

The dark reaction between N/10 H_2O_2 and M/300 $K_3Fe(CN)_6$ at $25 \pm 1°$ C. is exceedingly slow and shows an autocatalytic course with the progress of the decomposition. We have been wholly unable to observe a constant unimolecular rate of decomposition at any stage of the reaction. The ferricyanide solution, insolated for 20 minutes, produced a considerably higher rate of decomposition of the peroxide, but the course of this decomposition was likewise autocatalytic as that of the dark reaction. This after-effect is markedly increased by the addition of a suitable amount of uninsolated ferrocyanide to the reaction mixture, and what is more important, the unimolecular velocity constants maintain a fairly uniform, though much higher value throughout the course of the decomposition.

Dark reaction between H_2O_2 and $K_3Fe(CN)_6$

t	$a-x$	K.10^3
0	22·20	—
2885	21·90	203
3348	21·80	236
4300	21·65	253
6010	21·40	256
7817	20·90	336
8815	20·30	495
12792	18·80	564

Dark reaction between H_2O_2, $K_3Fe(CN)_6$ and M/300 $K_4Fe(CN)_6$*

t	$a-x$	K.10^6
0	20·40	—
81	19·70	186
235	18·80	149
448	16·30	217
775	12·50	274

* With $K_4Fe(CN)_6$ alone, apparently the same order of K is obtained.

Dark reaction between H_2O_2 and pre-insolated ferricyanide and M/300 ferrocyanide

t	$a-x$	K.10^6
0	22·40	—
965	21·00	29
1493	19·85	35
Added 0·038 gm. $K_4Fe(CN)_6$		
1631	12·40	—
1687	10·05	1627
1750	8·05	1553
1795	7·00	1515

A study of the irradiated aqueous solution of potassium ferricyanide has led us to the conclusion that an appreciable amount of potassium aquopentacyanoferrate is produced under the influence of radiation.

$$K_3Fe(CN)_6 + H_2O \rightarrow K_2Fe(CN)_5H_2O + KCN. \quad (I)$$

The presence of the aquo complex salt has been proved by a number of qualitative colour reactions. The aquo complex salt causes the measured photochemical after-effect.

The addition of $K_4Fe(CN)_6$ results in the reduction of aquoferrate to aquoferrite.

$$K_2Fe(CN)_5H_2O + K_4Fe(CN)_6 \rightarrow K_3Fe(CN)_5H_2O + K_3Fe(CN)_6. \quad (II)$$

Potassium aquopentacyanoferrite so produced causes a very rapid decomposition of H_2O_2 at a constant unimolecular rate in the presence of a suitable excess of ferrocyanide.

$$2K_3Fe(CN)_5H_2O + H_2O_2 \rightarrow 2K_2Fe(CN)_5H_2O + 2KOH + E. \quad (III)$$

It is suggested that the energy liberated in (III) causes the decomposition of a large number of H_2O_2 molecules. The catalytic system $Fe(CN)_5H_2O \leqslant Fe(CN)_5H_2O_2$ thus causes a uniform decomposition of H_2O_2 as measured by the after-effect.

Experimental evidence in support of the suggested mechanism of the photochemical after-effect has been adduced by studying the after-reaction in presence of CN', NO_2' and C_6H_5NO. The after-effect has been found to be very largely quenched in the presence of these substances. This is to be expected if the photoformation of potassium aquopentacyanoferrate

from ferricyanide is responsible for the after-effect. The quenching is produced because the highly reactive aquopentacyanoferrite ion is converted into much less reactive substances as follows:—

$$Fe(CN)_5H_2O''' + CN' \rightarrow Fe(CN)_6'''' + H_2O$$

$$Fe(CN)_5H_2O''' + NO_2' \rightarrow Fe(CN)_5NO_2'''' + H_2O$$

$$Fe(CN)_5H_2O''' + C_6H_5NO \rightarrow Fe(CN)_5C_6H_5NO''' + H_2O.$$

The above conclusions have been experimentally verified and fully substantiated by studying the decomposition by uninsolated ferricyanide and a trace of the photo-catalyst, scdiumaquopentacyanoferrate. We have been able to reproduce the photochemical after-effect in the dark by adding a trace of aquopentacyanoferrate ions to H_2O_2-$K_4Fe(CN)_6$ mixture. A quenching of this effect is also observed in the presence of CN', NO_2' and C_6H_5NO.

The details of the investigation will be published elsewhere.

Chemical Laboratories,
St. John's College, B. B. Lal.
Agra, C. P. Singhal.
August 9, 1943.

1. Kistiakowsky, W., *Zeit. Physikal. Chem.*, **1900**, **35**, 431. 2. Lal, B. B. *Jour. Ind. Chem. Soc.*, **1939**, **16**, 7. 321. 3. Qureshi, M., *Jour. Physical. Chem.*. **1931**, **35**, 656. 4. Lal, B. B., *Proc. Ind. Acad. Sci.*, **1941**, **14**, 652, 5. Rao and Srikantan, *Jour. Ind. Chem. Soc.*, **1933**, **10**, 29.

A NEW VARIETY OF *ISOACHLYA ANISOSPORA* (deBARY) COKER

In 1888, deBary[1] described a fungus as *Saprolegnia anisospora*. Recently its name has been changed to *Isoachlya anisospora* by Coker and Matthews[2] on sporangial characters. The present material was isolated from a pond, ten miles from Allahabad, using hempseeds as baits. All observations recorded below were made on cultures growing on hempseeds in distilled water.

Isoachlya anisospora (*deBary*) Coker, var. *indica*, nov. var.

Mycelium 8·18-16·36 μ thick. Spores of two kinds, smaller 9 μ in diameter while bigger ones upto 12 μ. Sporangia 14·5-21·5 μ thick and 99-163·63 μ long. Oogonia are spherical; terminal and also rarely intercalary; wall smooth; 37·14-92·85 μ mostly 60-66 μ in diameter; thickness of the wall 1·4 μ.

Antheridia present on all oogonia; long; androgynous and diclinous; applied by sides. Eggs 1-10 in number, never more than ten; 21·81-55·71 μ in diameter, mostly 24·54-35·45 μ; thickness of the wall 3 μ; not completely filling the oogonium; centric or subcentric.

I. anisospora var. *indica* differs from the main species in the structure of the egg which, in the present form, is either centric or subcentric (Figs. 1 and 2). In no case eccentric eggs were formed as described by Coker and Matthews for the main species. Since the egg structure in this form does not agree with that of the

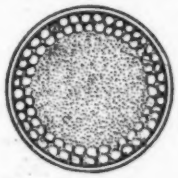


Fig. 1
A centric egg

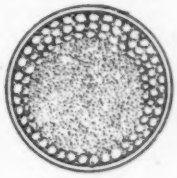


Fig. 2
A subcentric egg

American species, the authors consider it to be a new variety. Prof. W. C. Coker suggests us to call it a form of *I. anisospora*.

We thank Prof. W. C. Coker, University of North Carolina, U.S.A., for his kind advice, and also Prof. S. R. Bose, Carmichael Medical College, Calcutta, and Dr. John Dearness of Canada for communicating our description of the fungus to Prof. Coker.

Botanical Laboratory,
The University, R. K. Saksena.
Allahabad, K. S. Bhargava.
February 5, 1944.

1. deBary, A., *Bot. Zeit.*, 1888, 46, 619. 2. Coker, W. C., and Matthews, V. D., *North American Flora*, 1937, **2**, 17–58.

PROGRESS OF HOMOZYGOSITY DUE TO BACKCROSSING

According to Mendelian segregation in self-fertilized plants or in selfing cross-fertilized plants involving a single pair of genes, the fraction of the heterozygous individuals gets halved at every successive generation and at the end of a few generations a very large percentage of the population becomes homozygous. Where a large number of genes are concerned, the reduction in the percentage of heterozygous individuals is comparatively slow in the first few generations but later, say after ten generations, this percentage forms only a very small fraction of the population. The formula for determining the percentage of homozygous individuals in any generation following a cross is $\left(1 - \frac{1}{2^n}\right)^m$ where n is the number of segregating generations which have elapsed since the cross was made and m, the number of independently inherited pairs of genes involved.

Let us now consider this principle in the case of practical stock breeding, say, improving milk yield in cows. In herds which lack the genes controlling high yield of milk, they may be introduced through mating them to bulls known to possess these genes. The rate of transfer of the genes will be the speediest when the sires selected for mating are homozygous for all the genes involved and the progenies are back-crossed in each succeeding generation to these same individuals or mated

to others having an identical genetic constitution. The rate at which the genes for milk yield are established in a homozygous condition in the population from such matings, can now be calculated and this rate will be a measure of improvement to be expected in the population for the characters under consideration.

With a single gene, say A, carried by the sires all members of the first generation will be heterozygous (A*a*). On mating these heterozygotes again to AA individuals, half of the second generation progeny will be homozygous for A. The other half of the progeny will remain heterozygous and from the mating of this portion of the populations to AA individuals, a further half will be made homozygous in the third generation, assuming, of course, that all matings are equally fertile and yield the same proportion of survivals. Heterozygosity will thus be reduced by a half in each successive generation. The fraction of the population rendered homozygous for the gene A in each successive generation will thus be ½, ¼, ⅛, $^1/_{16}$ the total proportion of the population expected to become homozygous for the gene in the nth generation will, therefore, be the sum of $n-1$ such fractions, since homozygosity is nil in the first generation. The fractions from a geometric series with ½ as the leading form and ½ as the common ratio. The sum is $\left(1-\frac{1}{2^{n-1}}\right)$. If m genes are involved, that is, if the character under consideration is controlled by m genes, the fraction of the population expected to be homozygous for all m genes is obviously $\left(1-\frac{1}{2^{n-1}}\right)$.

By substituting in this formula different values of m, the number of genes assumed, and n, the number of generations, the rate at which the homozygosity increases in the population can be studied. Curves representing the homozygous fraction of the population in different generations are shown in Fig. 1 for the values of m equal to 1, 6 and 100.

If known fractions of the population already possess some of the m genes in a homozygous condition, the progress of homozygosity can still be worked out from the application of the formula separately to each fraction, assuming for the number of genes concerned the value m less the genes already existing in the fraction and taking a weighted sum of the results over the different fractions. For example, if six genes are involved and if $^1/_{10}$ of the population already possesses one of these genes, the homozygous fraction of the whole population in n generations will be

$$\frac{1}{10}\left\{1-\frac{1}{2^{n-1}}\right\}^5+\frac{9}{10}\left\{1-\frac{1}{2^{n-1}}\right\}^6$$

The resulting curve practically overlaps the one for six genes (i.e., when the whole population originally lacks in all six genes) and is not shown in the figure.

All curves are asymptotic and complete homozygosity is thus theoretically impossible to achieve in the system considered here; but over 99 per cent. of the population reaches this stage in the eighth, eleventh and fifteenth generations for 1, 6 and 100 genes respectively. In the initial stages also, with a single gene,

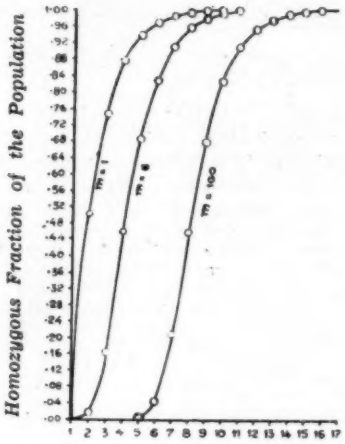


FIG. 1.—Progress of Homozygosity due to Backcrossing (m = No. of genes assumed to control the character)

half of the population becomes homozygous in the second generation, but no sensible homozygosity is found until the sixth generation in a population in which a hundred genes are segregating. The particular generation in which homozygosity is increased by the largest amount may be calculated with the help of the formula given above.

The increase in homozygosity in the nth generation over the preceding generation is

$$\left\{1-\frac{1}{2^{n-1}}\right\}^m-\left\{1-\frac{1}{2^{n-2}}\right\}^m.$$

Differentiating this expression with respect to n and equating to zero, we have

$$n=\frac{\log\left\{2\,\frac{2x-1}{x-1}\right\}}{\log 2} \quad \text{where } x=e^{\frac{\log 2}{m-1}}$$

for $m=1$, 6 and 100 the nth generation is second, fourth and eighth. It is thus clear that as the number of genes involved increases, the progress of homozygosity, i.e., the rate at which the genes are established in the population is retarded.

The results given above are derived purely from theoretical considerations and involve simple assumptions. In actual practice, however, the genetic situation is often more complicated as we cannot be sure of the genetic constitution of either the cows or the bulls. If the bulls used do not contain all the genes controlling the character or contain them only in a heterozygous condition the progress of improvement in the herd will be much slower than is shown here. That in cattle improvement the success of any breeding scheme

depends upon the selection of the bulls of the right genetic constitution needs no emphasis.

Cotton Genetics Research Scheme,
Indian Central Cotton Committee,
Institute of Plant Industry,
Indore, C.I., G. R. AYACHIT.
December 13, 1943.

ON THE OCCURRENCE OF *STREPTOCEPHALUS DICHOTOMUS* BAIRD IN TRAVANCORE

ON 8-12-1943, I made a collection of small shrimp-like crustaceans from a fairly big pool of water about half a mile north of the Aquarium building and about two and a half furlongs inland from the Trivandrum beach. These were identified as the fairy-shrimp *Streptocephalus dichotomus* Baird.[1] About hundred specimens were brought to the laboratory and are being reared for further studies. The pool from which the collection was made is a temporary piece of water in a sandy depression which completely dries up during summer. It contained tufts of decaying grass and organic debris, together with some aquatic fauna such as tadpoles, water fleas and insect larvæ. The water at the time of collection had a pH of 7·7 and its oxygen contents was ·46 per 100,000 parts.

These were observed to move about in shoals of 400-500 and normally prefer the deeper parts of the pool. They are transparent and hardly recognisable except for their pigmented eyes and deep orange-red anal lobes. The brood pouch in the female has an orange-red streak on its ventral surface and the second pair of modified antennæ in the male is slightly bluish in tint. The females were fully mature and their brood pouch contained ripe eggs in various stages of extrusion. The specimens measured from 19-22 mm., the males being slightly the longer. Two forms of this species, *viz.*, the typical form as well as a variety *simplex* have been observed to occur together by Gurney,[2] but in the present collection only the typical form with four cirriform appendages at the distal end of the proximal antennal segment has been found to exist.

Only two species of *Streptocephalus, viz., S. dichotomus* Baird and *S. spinifer* Gurney, have been so far recorded from India and Ceylon and of these, the latter species has been found only from Ceylon.[3] The former species has been recorded several times from various other parts of India, both from very high altitudes as well as the plains. The present collection extends further the range of distribution of this species in India.

Marine Biological Laboratory,
University of Travancore,
Trivandrum, K. GOPINATH.
January 3, 1944.

1. Synonymous with *Branchipus (Streptocephalus) benjalensis* of Alcock, *Journ. A.S.B.*, **1896, 65,** 538-39, pl. 10. 2. Gurney, *Ibid* (n.s.), **1907, 2,** 276. 3. Kemp, S., *Rec. Ind., Mus.*, **1911, 6,** 222.

OCCURRENCE OF A NEW VARIETY OF THE SKATE, *UROGYMNUS ASPERRIMUS*, AROUND KRUSADAI ISLAND, GULF OF MANAAR[1]

THE Skate of the genus *Urogymnus* contributes to a fishery of moderate scale around Krusadai and neighbouring islands and the lagoons of Pamban, Gulf of Manaar, from October of one year to February of another year. They are captured by means of stake nets, which are set near the shore especially during New Moon and Full Moon days.

The Skate, on examination, shows the following differences from *Urogymnus asperrimus*,[2] the only species recorded by Day.

Distinguishing characters.—Snout does not project. Scales covering the body are mostly quadrangular in shape. The tubercles on the body are continued posteriorly to the first third of the tail. Where the pectoral fins meet in front of the snout, the outline is not roundish as in *Urogymnus asperrimus*, but is pointed out as in *Trygon sephen*.

Colour.—Body whitish above with black blotches on the head and on the tail, and milk-white below. A U-shaped black line between the eyes. The pectoral fins are greyish with round whitish spots of diameters varying from 3 to 10 mm.

The Director of Zoological Survey, to whom a specimen was sent, is of opinion that the differences noted above do not justify the creation of a new species for the Krusadai form. But, as all specimens recorded in this area show the above differences, the Krusadai form is given the status of a new variety, namely, *Urogymnus asperrimus* var. *krusadiensis*.

Fisheries Bureau,
Triplicane, Madras, P. I. CHACKO.
February 18, 1944.

1 Published with the permission of the Director of Industries and Commerce, Madras.
2 Day, F., *The Funa of British India, Fishes*, 1889, 1.

A PRELIMINARY NOTE ON THE BREEDING OF A BENEFICIAL ECTOPHAGOUS LARVAL PARASITE (BRACONIDÆ) ON A LABORATORY HOST

As a result of several attempts made very recently in this Laboratory a measure of success has been finally achieved in the matter of rearing out *Microbracon hebetor*, the larval, natural parasite of the Lab-lab Pod-borer, *Adisura atkinsoni*, on the larva of *Corcyra cephalonica* St., the common caterpillar pest of stored rice, jola and flour. The larvæ of *Corcyra cephalonica* St., the laboratory host, were offered to the parasites under environmental conditions, somewhat simulating those obtaining in a crop of Lab-lab.

One generation of twenty-two parasites, nine males and thirteen females, was reared out from a culture of six host larvæ, to which a batch of five natural parasites (two females and three males) recovered from field-parasitised pod-borers, was introduced; four of the

six host larvæ in this culture were successfully parasitised.

In a second culture, also treated with parasites emerged from field-parasitised pod-borers, one successfully parasitised host-larva, yielded two parasites (one male and one female).

From a third culture exposed to a mixture of a few parasites of the first generation bred from the first culture and others emerged from field-parasitised pod-borers, a third set of eight parasites (one female and seven males) from two successfully parasitised host-larvæ, emerged out. In the second and third cultures, the prevalent micro-climatic conditions were not quite typical of those present in the first.

As far as the writers are aware, this is the first instance, in India, of successful breeding of this beneficial larval parasite on a host, other than its natural host; i.e., on a laboratory host. It may not be out of place, here, to state that the egg of this same laboratory host, *Corcyra cephalonica* St., is already being used for the past ten years, at the Mandya Parasite Laboratory, for the mass-production of the beneficial egg-parasite, *Trichogramma minutum* R., utilised against the destructive stem-borer pest of sugarcane, in the Irwin Canal tract.

This, now, opens up possibilities of mass-rearing, in the laboratory, *Microbracon hebetor*, and probably other beneficial larval parasites for utilisation in the biological control of certain harmful pests, which are at present, being controlled by other methods.

Entomological Laboratory,
Department of Agriculture,
Bangalore, B. KRISHNAMURTI.
March 10, 1944. D. SESHAGIRI RAO.

ON THE OCCURRENCE OF *CNAPHALOCROCIS MEDINALIS* AS A PEST OF PADDY IN TRIVANDRUM AND THE INDIGENOUS METHOD OF COMBATING THE SAME

VERY recently some of the late-sown paddy fields in Trivandrum showed heavy attack by this insect pest which, as a rule, appears only occasionally. In those fields sown at the proper time the injury was slight but in the late-sown fields the seedlings were tender and weak and the depradations of the insect were most obvious. In two or three blocks all the seedlings had become whitened and sickly and from a distance looked as if lime had been splashed over the whole field.

The way the local peasants handled the situation was very ingenious and interesting. They brought twigs of a wild tree—*Holigarna arnotiana* (Anacardiaceæ) and moved them amongst the seedlings and even planted them amidst paddy seedlings. In a fortnight the seedlings began to recover. On examination these fields were found to be crowded with spiders of various types. Towards dusk the spiders were busy spreading their snares in all directions. The innumerable snares formed a sort of canopy on the seedlings, and the moths that emerged at night were very probably destroyed by these spiders. Other spiders (Attidæ) were noted destroying the caterpillars which are directly responsible for the damage to the paddy.

This method of control is a very simple, yet efficient type of biological (Predatorism) control, used by a people most of whom are illiterate. In January 1944, the fields referred to above presented a different spectacle. The insect pest was not at all seen. The crop had mostly recovered. The abundant spider fauna had also reduced to a small number.

Spiders form a large group of exclusively insectivorous animals. They naturally play an important part in the biotic control of insects in any locality. But little attention has been given to their role in the balance of nature and very little effort has been made to estimate or understand the service rendered by this group of animals to human welfare. The above-mentioned observation is a very vivid attempt on the part of the illiterate Indian cultivator to make use of these creatures for his purpose.

In the course of certain observations on the destruction of insect pests by spiders around the writer's house in Trivandrum large numbers of spiders were found busy spreading their snares which were observed, to contain, in addition to sucked up bodies of the major victims innumerable gnats and mosquitoes entangled in the viscid threads. These gnats and mosquitoes on the spider webs near the doors and windows of the house, indicated that they were probably attracted by the light in rooms and that they would have got in, but for the interception of the silky webs.

A large spider (Herennia) which had made its snare on the bark of a tree, destroyed certain hairy caterpillars which attempted to climb that tree.

The common house spider (Heteropoda) is well known as a destroyer of cockroaches and such other undesirable insects intruding into the household.

In the local wooden granaries several forms of spiders building their webs inside are probably responsible for destroying many adult moths (*Sitotroga cerealella*) a common pest of stored paddy, and keeping down the incidence of the pest.

The foregoing instances would clearly demonstrate that these much neglected animals form a very important cog in the wheel of life, serving as natural check on the undue increase of insect pests, especially in the tropics and deserve much more attention and recognition than has been usually bestowed on them.

Zoology Department,
University College,
Trivandrum, A. P. MATHEW.
January 15, 1944.

A HOME FOR THE LEPERS

"Poor without kin or friend or ties of blood am I
Save me, before it be too late from this, my curse."

THE "curse" has assumed a dreadful shape. We have to-day a half of world's lepers amidst us. Fighting this malady out is pretty difficult. But fight we must somehow. Success depends on co-ordinating the work hitherto done and the Central Government taking the initiative. The problem may be examined under four heads, namely, Investigation, Segregation, Treatment and Control.

Investigation consists in ascertaining the exact numbers suffering as also the enlistment of new cases, the best instruments for that being the Public Health Department and the medical profession in general. But investigation can be successful only with the patients' co-operation ensured through propaganda and promise of attractive life within the Leprosaria. One method is a systematic examination of school children, college students, employees of Government Departments and commercial houses.

Segregation is the organisation of Leper Colonies, climatic suitability and sanitation being of primary importance in selecting sites. Each must accommodate: (1) those to whom the disease is a newly begotten wealth, those sufferin⁻ for a long time and those in whom the disease is extinct, (2) intimate relations, dependants, children born in the Leprosarium and the healthy children of the patients.

Education, social amenities and economic self-sufficiency are important. Agriculture and small industries may be made the chief occupations for the milder cases. A Leprosy Expert, assisted by an Administrative Officer and a host of medical men, will be the Colony-Chief. A Research Laboratory attached to the Leprosarium will have three qualified scientists who will be in constant touch with the Federal Leprosy Institute, working independently on different aspects of the disease.

We are still Atreyan in the matter of treatment makes necessary the establishment of a Federal Council of Research to devote its complete attention to Leprosy research. The governing body must consist of a Member of the Viceroy's Executive Council, Director-General of Medical Services, Director of the Indian Institute of Science, Director of Industrial Research and the Director of the Federal Leprosy Institute attached to the Council, with the Assistant Director as its Secretary. The Council shall conduct a Journal, namely, *The Transactions of the Federal Institute of Leprosy* as also a special course in Leprosy.

Control can be made easy and effective by restricting the number of Leprosaria to one for each Province and making the Director of Public Health its administrative head, administration of justice being entrusted to the nearest magistrate. A new "Indian Leprosy Act" will set the scheme in motion.

Madras, M. PADMANABHAN.
March 6, 1944.

* I am thankful to Dr. M. K. Subramaniam for the interest created in the subject.

THE CRITICAL DISCHARGE OF STREAMS IN UNIFORM FLOW

IN two recent communications,[8,9] the writer has shown how to deal with the problem of the critical shear stress. There are in use, two more methods of correlating the particle characteristics with the hydraulic elements of streams, when the sediment particles, initially lying quiescently on their beds, are ejected and propelled forward. These are respectively known as *the critical discharge* and *the critical mean velocity* relations.

At present, there is no satisfactory solution of these, any existing formulæ being true for certain special particle sizes and with little physical significance.

However, the writer has made certain satisfactory calculations of these, and their full account will be published elsewhere. In this note and a subsequent one, I summarise these, the present note being devoted to the question of the critical discharge and the relevant calculations.

There are various ways of arriving at the same result. One of these is to obtain it from the solution of the critical shear stress, there being two lines of attack. Both of these are quite general, but the procedure we adopt here appears to be more significant. It establishes in an instructive and convincing manner, the close interrelationship between the various critical relations. And so, the claim of superiority for one over the others, made by some of the investigators,[7,10] appears to be invalidated.

The law of the critical shear stress velocity for particles with the same fineness ratio reads

$$U\tau_c/V_s = f(\rho_w U\tau_c k/\mu) = F(\rho_w V_s k/\mu), \quad (1)$$

where

$U\tau_c = \sqrt{\tau_c/\rho_w}$ = critical shear stress velocity at the bed $[L\,T^{-1}]$, τ_c $[M\,L^{-1}\,T^{-2}]$ being the critical shear stress at the stream bed,
μ = fluid viscosity $[M\,L^{-1}\,T^{-1}]$,
ρ_w = fluid density $[M\,L^{-3}]$,
V_s = terminal velocity of the sediment particles $[L\,T^{-1}]$, and
k = particle diameter $[L]$.

In this, we first split up $U\tau_c$ and write it as $(U\tau_c^2 \cdot U\tau_c^3 \cdot U\tau_c)^{1/5}$. Then making use of the equality

$$U\tau_c^2 = g\,D_c\,i_c, \quad (2)$$

where

g = acceleration due to gravity $[L\,T^{-2}]$,
D_c = critical channel depth $[L]$, and
i_c = critical channel slope $[-]$,

we get for $U\tau_c$, the equivalent expression

$$(D_c\,i_c)^{1/5}\,(g^2\,D_c\,i_c)^{1/5}\,U\tau_c^{1/5}. \quad (3)$$

We next multiply this quantity by $\left(5{\cdot}75\,\log_{10}\frac{0{\cdot}4\,D_c}{y_0}\right)^{1/5}$ and divide it by $(D_c\,i_c)^{1/5}$, where y_0 [L] is a small distance inwards from the bed, where the velocity is taken as zero. Both of these are non-dimensional, $(D_c\,i_c)$ being divided by a unit width. Hence, as the critical mean velocity relation reads

$$\bar{U}_{mc} = 5{\cdot}75\,U\tau_c\,\log_{10}\frac{0{\cdot}4\,D_c}{y_0}, \quad (4)$$

we get

$$U_{Qc}/\bar{V}_s = f_1(\rho_w U\tau_c k/\mu) = F_1(\rho_w V_s k/\mu) = F_1(\rho_w \bar{U}_{Qc} k/\mu), \quad (5)$$

where $\bar{U}_{Qc}$ $[L\,T^{-1}]$ is short for $g^{2\cdot5}\,Q_c^{1/5}\,i_c^{1/5}$, Q_c being the critical discharge intensity. This *new variable* has the dimensions of a velocity and so we call it *the critical discharge velocity*.

In sharp contrast to the existing relations, each of these has been verified against very extensive experimental data obtained from independent sources. Table I, recording the approximate lower and upper limits of the various variables (ordinarily varied), gives an idea of the range of the data employed, whereas Fig. 1, typical of its kind, demonstrates the high correlation of the data on these bases.

The figure shows how the critical discharge

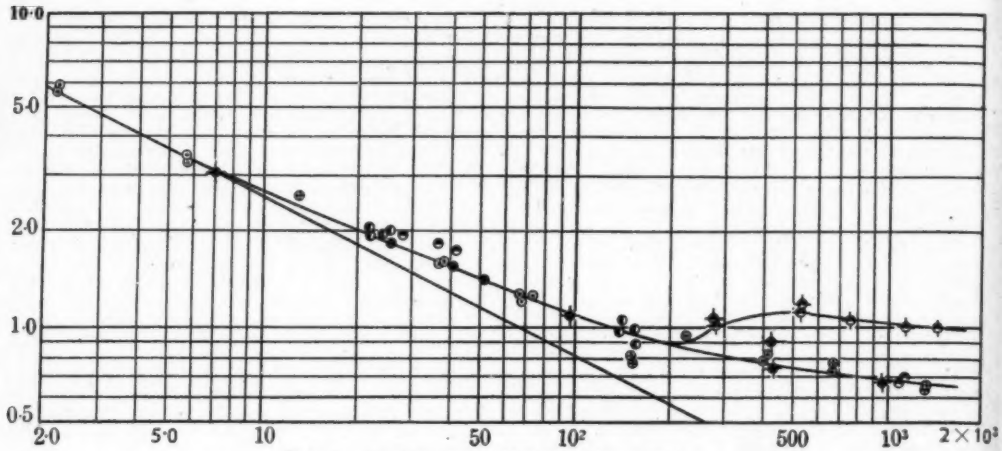


FIG. 1. Analysis of the Critical Discharge Data.
$\bar{U}_{Qc}/V_s$ Plotted against $\rho_w V_s k/\mu$

Observations with uniform grains: ⊙ Casey[2]; ⊕ Gilbert[3]; ⊛ Srichamara[11].
Observations with mixtures: ◐ Casey[2]; ⊕ Ho[4]; ● Kramer[5]; ◓ U. S. Waterways Experiment Station.[12]

velocity (so also the critical discharge intensity) varies with the Reynolds Number. In particular, it establishes that the critical discharge will vary if changes are made in the viscosity of the fluid. This is confirmed by an experimental investigation conducted by Ho[4].

TABLE I
Showing Lower and Upper Limits of the Various Variables in (5)

Variable		Lower Limit	Upper Limit
$U\tau_c$	(cm./sec.)	1·54	7·68
$\bar{U}_{Qc}$	(cm./sec.)	8·67	22·44
V_s	(cm./sec.)	1·50	23·50
k	(mm.)	0·175	6·99
$\rho_w U\tau_c k/\mu$	(–)	2·12	467·00
$\rho_w \bar{U}_{Qc} k/\mu$	(–)	12·53	1370·00
$\rho_w V_s k/\mu$	(–)	2·16	1430·00

While observations show the various non-dimensional groupings in (5) to be true,* practice reveals them to be somewhat inconvenient, specially when the particle sizes corresponding to given values of the critical discharge velocities are to be determined. But it is quite easy to deduce expressions, obviating this inconvenience. All we need do is to extend to (5), the reasoning applied to the case of the calculations of the critical shear stresses and the sediment sizes.[9] By doing this, we get the result

$$\frac{\bar{U}_{Qc}^3}{\left(\frac{\rho_s}{\rho_w}-1\right)gk} = F_2\left[\left(\frac{\rho_w}{\mu}\right)\frac{\bar{U}_{Qc}^3}{\left(\frac{\rho_s}{\rho_w}-1\right)g}\right] = F_3\left[\left(\frac{\rho_w}{\mu}\right)^2\left(\frac{\rho_s}{\rho_w}-1\right)gk^3\right], \quad (6)$$

in which the dependent variable is expressed in terms of parameters which are made up of ρ_s, ρ_w, μ, g and either $\bar{U}_{Qc}$ or k. Here $\rho_s[M\,L^{-3}]$ is the sediment density.

These functions check well against a large amount of observational material. The curves plotted according to them possess very significant properties and give rise to certain interesting relations. We, however, detail these elsewhere. Here we shall make only one general observation, which concerns the slope-discharge relations suggested for use in the design of stable channels.[1,6,13] *This is that in the light of our analysis, which is seen to be fairly comprehensive, such relations are not true of form and lack any general validity.*

Jamnadas Dewanmal Road,
Ratan Talao,
Karachi, MOHD. SALEH QURAISHY.
November 25, 1943.

* I hope to revert to the problem at some future date, when I shall deal with certain anomalies and their solution.

1. Bose, N. K., and Malhotra, J. K., *Res. Publ. Punj. Irrig. Res. Inst.*, 1939, **2**, No. 23. 2. Casey, H. J., *Dissert. Dok. Ing. Tech. Hoch. Berlin*, 1935. 3. Gilbert, G. K., *Prof. Pap. U. S. Geol. Survey*, 1914, No. 86. 4. Ho, P. Y., *Dissert. Dok. Ing. Tech. Hoch. Hannover*, 1939. 5. Kramer, H., *Ibid., Dresden*, 1932. 6. Lacey, G., *Centr. Bd. Irrig. Publ.*, 1939, No. 20. 7. Meyer-Peter, E., Favre, H., and Einstein, H. A., *Schweiz. Bauztg.*, 1934, **103**, 147–50. 8. Quraishy, M. S., *J. Univ. Bomb. Phys. Sci. No.*, 1943, **13**, Pt. 3, 37–46. 9.—, *Curr. Sci.*, 1943, **12**, 233–34. 10. Schoklitsch, A., *Wasserkr. u. wirtschaft*, 1934, **29**, 37–43. 11. Srichamara, P., *Ph. D. Thesis, Univ. London*, 1938. 12. U. S. Waterways Expt. Stn., *Pap.*, 1935, No. 17. 13. White, C. M., *Rep. Assoc. Inter. Hydrol. Sci., Cssion. Potem.*, 1939, Q. 3, No. 1, Washington.

REVIEWS

Annual Review of Physiology, Vol. V.—By James Murray Luck and Victor E. Hall. (American Physiological Society and Annual Reviews, Inc., Stanford University, P.O. California), 1943. Pp. viii+613. Price $5.00.

Twenty-two themes are covered by the Annual Review for the year 1943; most of them are devoted to a discussion of the advances made in the field of physiological tissues and tissue-fluids, like the bone, the muscle, the liver, the nerve, the blood, the bile and the mammalian semen. The review includes a critical review of the physiological and pathological effects of ultra-violet radiation, in which reference has been made to the relatively high incidence and nature of mutations induced by ultraviolet radiation as compared with the changes brought about by X-rays. In discussing the relation of ultra-violet radiation to cutaneous cancer, the author significantly remarks, "The possibility that the carcinogenic action of ultra-violet radiation resides in its ability to induce mutations in somatic cells has been suggested. There are many interesting parallels between the two phenomena, and the hypothesis must be seriously considered although the existing evidence may be interpreted in other ways."

The useful review of the physical properties of protoplasm will interest the growing number of cytologists who are interested in elucidating the nature of this fundamental living matter. Geneticists will feel particularly interested in the highly stimulating and able review on the physiological aspects of genetics. The author has drawn attention to the fact that nucleoproteins constitute the common basis on which the two self-reproducing entities—the virus and the gene—are built up. Those interested in the microbiological assay of vitamins will find much useful information on the possibility of evolving new mutants capable of responding to specific vitamin deficiencies.

In the course of the active prosecution of the war, the human organism is being subjected to abnormal conditions of existence, both at the home and the battle fronts. Men and women working in the munition factories at high pressure, pilots flying at and dive-bombing from high altitudes, navigators at and under the sea, men in the land fighting, are obliged to subject themselves to stresses and strains to which their body is not ordinarily accustomed. The extent of the strain which the various parts of the organism can bear without impairing its normal function, has lately formed the subject of intensive physiological investigations now under way. Although much of this work will necessarily remain a close secret for the duration of the war, glimpses into such types of study are, however, discernible in some of the reviews contained in the volume. Reviewing the physiology of the respiratory system, Lt.-Commander Gemill writes, "A tremendous interest is being taken in the latter (anoxia) in view of its practical nature in aviation. However, it must be kept in mind that only when an aviator goes above 35,000 feet while breathing pure oxygen does he become anoxic. Even at 40,000 feet, his anoxic symptoms are very slight. Therefore, anoxia is a very small problem in aviation as long as the aviator is supplied with adequate oxygen. The results of many investigators in the field of anoxia and in the methods of supplying oxygen to the aviator cannot be published until the war is over. It may be said, however, that many advances in physiology of respiration will be made during these crucial war years."

These reviews are indispensable not only to advanced investigators in the field of physiology but also to the progressive medical man who wishes to keep himself abreast of the developments in physiology.

Carnegie Institution of Washington Year-Book No. 41, 1941-42, Washington, D.C., 1942.

The research activities of this great Foundation for the year ending 31st October 1942 form the subject of an interesting report by the President of the Institution. The entire facilities and the resources of the Institute were mobilised for the promotion of war effort. The President adds, "After Pearl Harbour this country ceased to be an oasis in a world at war, and entered upon a period of strife and sacrifice. To the Institution there is an intensified opportunity to serve the nation in its peril, and the effort indeed calls for the sacrifice of precious things. To only a minor extent can we still hope to continue progress in paths of research toward distant cultural objectives, and by keeping the road open avoid the loss of ground already gained. Not all scientific talents are of such nature as to be immediately and directly applicable to the waging of war, and hence the transition has occurred more rapidly in some departments than in others. The utmost effort of our research, however, wherever it has been possible to divert it successfully, is directed toward placing more powerful weapons in the hands of the youth of the land and toward devising means better to protect their health in combat, by guarding against the rigours of disease and unnatural stress. To the extent of our ability and resources and to the full effort of our personnel as it becomes determined how they can best serve, the Institution is committed to the service of the nation at war."

Arrangements have been made for the installation of a cyclotron at the Department of Terrestrial Magnetism. A comparative study of the genetic effects induced by X-rays, ultra-violet radiations and neutrons is being made in the department of genetics. The fibre-yielding hemp and the rubber-bearing Russian dandelion have been both subjected to polyploidy investigations.

Sandstone Water-Supplies of the Joliet Area, Bulletin No. 34 of the State Water Survey Division, Illinois, 1941. Pp. 128.

A progressively increasing demand for water and a steady recession of the water-level in the wells of the Joliet-Washington-Morris area prompted the preparation of this report which deals with 49 municipal and industrial supplies derived from over 100 wells. The report includes a map of the area, complete logs of the wells and the results of chemical examinations of the waters.

Water is obtained from three sandstones which are separated from each other by impermeable beds—(1) *the St. Peter* sandstone, occurring at a depth of about 650-700 ft. and extending to a thickness of 150-200 ft.; (2) *the Galesville* sandstones (100-200 ft. thick), occurring at a depth of about 1,300 ft.; and (3) *the Mount Simon* sandstone, occurring at depths of 1,500 ft. or more. The limestones and dolomites overlying the St. Peter sandstones also yield water to a varying degree depending on the extent to which they are cracked and creviced.

Not only is the hydrostatic pressure of each formation different but this pressure also varies from one locality to another. When wells are drilled to open up every water-bearing formation, the resultant hydrostatic pressure is a balancing of the individual pressures.

During the period of 25 to 30 years the wells have shown considerable recession in water-levels amounting to as much as an average of 62 ft. per year in one case. The absorption-area of these aquifers is in the South and Central Wisconsin and it is stated that the rate of movement of groundwater is as low as 100 ft. per year so that the rate of recharge of storage would be too slow to be of value in Illinois irrespective of the precipitation in the absorption area.

Water from any one formation at a particular location is of distinct composition. But the quality of water obtained in a borewell depends on the effectiveness of sealing off the other water-bearing strata.

Waters occurring in the limestone, shale and dolmite are very variable in composition. They are usually very hard and contain large amounts of sulphates but, occasionally, zones of soft water are encountered.

In some places, the limestones are able to yield as much as 100-150 gallons per minute (g.p.m.) so that there is considerable chance of this water contaminating the water from the upper sandstones. The St. Peter sandstones yield about 75-100 g.p.m., the Galesville, about 600 g.p.m. The Mt. Simon sandstones are very prolific yielders but the water has a very high salt-content. Wells drilled in this formation are, therefore, capable of influencing the mineral quality of wells in the immediate vicinity because the high hydrostatic pressure forces salt-water into the upper aquifers of lesser hydrostatic pressure. It has frequently been found necessary to plug back wells drilled to reach this formation.

The authors have taken great pains to collect complete and authentic data regarding the strata, the yield and chemical features of the water. The book is attractively got up and would prove useful to students of hydrology.

K. V.

SCIENCE NOTES AND NEWS

Patulin—A Remedy for Common Cold.—Dr. N. K. Basu, Pharmacologist, Scientific and Industrial Research, Delhi, writes:—

Current Science in February 1944 has published a short note on the subject. As it might create a wrong impression in the mind of the lay public regarding the wonderful activity of the substance, the following note appearing in the *Industrial Chemist and Chemical Manufacturer*, December 1943, might be placed before them.

"Considerable publicity has been given of recent weeks to this substance Patulin, which the *British Medical Journal* refers to as the antibacterial derivative of *Penicillin patulum* Bairiar, and the controversy has already started. A sample of the preparation had been sent to the laboratories of the Imperial Cancer Research Fund for therapeutic tests in cancer, and W. E. Gye, suffering at the time from a severe cold, tried a solution of it as a nasal douche. Since then a large-scale clinical trial has been carried out at a naval establishment with satisfactory results. But clinical trials at a primary training wing by officers of the R.A.M.C. led them to conclude that Patulin had no demonstrable effect on the course of the series of colds that were treated. Here we have one of those perfect instances where experts disagree." The *British Medical Journal* sums the situation very neatly by suggesting that serious attempts should be set on foot to elucidate the processes involved in the use of a mould preparation to obtain inhibitory action on the growth of viruses; and there possibly the matter can rest until some more work has been carried out.

Dr. Ralph W. Philips, Expert on Animal Genetics in the United States, Department of Agriculture, has been invited by the Government of India to study the position of cattle breeding in this country and suggest a long-range programme for adoption during the post-war period. He is touring India with a view to obtain first-hand knowledge of the problem.

Six young Holstein bulls which were purchased by the British army from a large dairy farm near Chicago, will be shipped to India to breed the sacred "Brahma" cattle. In this

connection the *New York Herald Tribune* observes editorially that this shipment of bulls is in a sense repayment of the old debt which the American cattle industry owes to India.

"Forty years ago when James Wilson was the Secretary to the Agricultural Section, a small shipment of 'Brahma' bulls was brought to South Texas to be crossed with beaf cattle there. Wilson believed, along with farsighted cattlemen, that the progeny would be able to withstand the terrific heat in South Texas and be more resistant to disease. The experiments turned out well. To-day there are tens of thousands of descendants of these 'Brahma' bulls."

The Advisory Board of the Imperial Council of Agricultural Research, at its annual session held recently in Delhi, decided to appoint a Sub-Committee to put up proposals for post-war reconstruction in the spheres in which the Council is interested. The memorandum prepared by this Sub-Committee will be considered by a special meeting of the Advisory Board of the I.C.A.R. before being submitted to Government.

Addressing the joint session of the Council of State and the Legislative Council, held on Thursday, the 17th February 1944, H. E. the Viceroy declared: "The post-war world will be, for India, a world of great opportunities and great dangers, in which she has an outstanding role to play. It is our present business to prepare her, materially and morally for these testing years.

"Let us count the blessing first, India has great undeveloped resources, in agriculture and industry. Her soil is not yet cultivated to its full fruitfulness; with an improvement in methods in irrigation and in fertilization, we can increase our food supply greatly, both in quality and quantity. We can much improve the breed of cattle. There is wide scope for development in India's main industry—agriculture.

"There are also great commercial possibilities in India. There are mineral resources still undeveloped; there is abundant labour, a portion of which has now attained a considerable degree of technical skill. India has many experienced and able men of business. Her financial position at the end of this war should be a good one. There are almost unlimited markets, internal and external, for her produce.

"Such are her main common assets. She has, however, also many economic difficulties and disabilities. The pressure of increasing population, the small percentage of educated persons, the low standard of health services, the poor conditions in which the greater part both of the agricultural and labouring populations live, the flagrant contrast between wealthy and poor, the inadequacy of communications, all mark the immensity of the problem which confronts India in raising the standard of living.

"Our task is to use rightly, and to best advantage her great economic assets not to increase the wealth of the few but to raise the many from poverty to a decent standard of comfort. A hard task indeed, but a noble task, which calls from all a spirit of co-operation, a spirit of hope and a spirit of sacrifice.

"The present Government means to prepare the way for India's post-war development with all earnestness of spirit and with all resources, official and non-official, which it can enlist."

It is officially announced that the Egyptian Government are allocating £1,500,000 from the general reserve to combat malaria in Southern Egypt. The credit will be met by supplementary taxes on landowners in the malaria-affected provinces.

Khan Bahadur Afzal Hussein, Vice-Chancellor of the Punjab University, and Mr. C. H. Parr, Imperial Agriculturist, have been deputed by the Government of India to attend the Agricultural Development Conference at Cairo. Mr. Parr has suggested to the Conference the formation of an international league to deal with problems of soil erosion which is becoming menacingly serious. Khan Bahadur Afzal Hussein advocated the institution of a chain of agricultural research stations as an integral part of every university.

The Chronica Botanica Co., of Waltham, Mass., has issued a special edition of Dr. C. A. Browne's "Thomas Jefferson and the Scientific Trends of his Time" (an advance reprint from *Chronica Botanica*, Vol. 8) on the occasion of the tenth anniversary of its establishment. The Chronica Botanica Co. was founded in Leiden, the Netherlands, in September 1933 and was transferred to the U.S.A. early in 1940. An old interesting, symbolic engraving, reproduced on an insert with the commemorative booklet, recalls the successful transfer of the firm's entire stock and their unique collection of source material in the history of botany and horticulture, just a few months before the invasion of the Low Countries. The firm, which is directed by Dr. Frans Verdoorn, publishes *Chronica Botanica, A New Series of Plant Science Books*, and *Annales Cryptogamici et Phytopathologici* (formerly *Annales Bryologici*). Special projects in the course of preparation include: "Plants and Plant Science in Latin America" and the "Index Botanicorum".

In reply to a question in the Central Assembly, Sir A. Ramaswami Mudaliar revealed that agricultural machinery valued at 1,107,000 dollars had been received from America under Lend-Lease up to the end of October 1943. This machinery included tractors, scrapers, ploughs, rooters, milk cans, hay-balers, pasteurisers, harrows and cultivators. Agricultural machinery worth 1,042,000 dollars had been distributed to military centres, Government dairy farms and the balance, worth 65,000 dollars, would be distributed to essential users through stockist agents.

Sir C. V. Raman, Kt., F.R.S., N.L., has been invited to address the Royal Society of Arts on "The Progress of Science in India".

The Persian Cultural Mission, led by Professor Ali Asghar Hikmat, is visiting important

centres of learning and research in this country. Referring to the Mission's visit to the Imperial Agricultural Institute, New Delhi, Professor Hikmat declared that it was one of the institutions of which they wanted Iran to take the fullest advantage. He hoped to send agricultural graduates from Teheran to the Institute for advanced studies.

India is expected to reach a state of self-sufficiency in 1945 with respect to her needs of vegetable seeds. A scheme for the production of acclimatised European vegetable seeds has been taken up in Kashmir and Beluchistan with financial assistance from the Imperial Council of Agricultural Research.

MAGNETIC NOTES

Magnetic conditions during February 1944 were less disturbed than in the previous month. There were 19 *quiet* days, 9 days of *slight* disturbance and 1 day of *moderate* disturbance as against 5 quiet days, 22 days of slight disturbance and 1 day of moderate disturbance during the same month last year.

The quietest day during February 1944 was the 27th and the day of the largest disturbance the 7th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Moderate
1–6, 12, 16, 17, 19, 21–29.	8–11, 13–15, 18, 20.	7

No magnetic storm occurred during the month of February 1944 while one moderate storm was recorded in February last year.

The mean character figure for the month of February 1944 was 0·38 as against 0·86 for February 1943. A. S. CHAUBAL.

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"Nature," Vol. 152, Nos. 3860-65, 3867-68.

"American Museum of Natural History," Vol. 52, No. 3.

"Journal of the Bombay Natural History Society," Vol. 54, No. 2.

"Journal of Nutrition," Vol. 26, No. 3.

"Indian Journal of Physics," Vol. 17, No. 4.

"Journal of Research of the National Bureau of Standards," Vol. 28, Nos. 3 to 6; Vol. 29, Nos. 1, 3-4; Vol. 31, Nos. 1 to 3.

"Science," Vol. 95, No. 2477; Vol. 96, Nos. 2470-81, 2483, 2486, 2498, 2502; Vol. 98, Nos. 2542-2545.

"Scripta Mathematica," Vol. 9, No. 2.

"Science and Culture," Vol. 9, Nos. 7-8.

"Monthly Science News," No. 28.

"Sky and Telescope," Vol. 2, No. 12; and Vol. 3, No. 1.

"Indian Trade Journal," Vol. 152, Nos. 1960-64.

BOOKS

Experiment and Theory in Physics. By Max Born. (Cambridge University Press), 1943. Pp. 44. Price 2*sh.*

Clouds and Whether Phenomena. By C. J. P. Cave. (Cambridge University Press), 1943. Pp. 22. Price 5*sh.*

Are Wars Inevitable? By John R. Swanton, 1943. Pp. 36.

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Control of the Indian Electricity Supply. By K. V. Karantha, 1944. Pp. 58. Price Annas 12.

Geology for Every Man. By Sir Albert Seward. (Cambridge University Press), 1943. Pp. 312. Price 10/6.

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Industries in Bombay City Monograph 3. (All-India Manufacturers' Organisation), 1943. Pp. 16. Annas 12.

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"Annual Review of Biochemical and Allied Research in India, Vol. 13 for 1942. (Society of Biological Chemists, India, Bangalore), 1943. Pp. 101. Price Rs. 3 or 6*sh.*

ERRATA

"Patulin," Vol. 13, No. 2, p. 34, line 2, *for* "*Penicillium notatum*, Bainier" *read* "*Penicillium patulum*, Bainier".

"Origin of Curves in Rivers," Vol. 13, No. 2, p. 38, *for* Fig. 2A with water please refer to p. 278 of Vol. 12, October 1943.

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